Exhibit A

1   UNITED STATES DISTRICT COURT

2   NORTHERN DISTRICT OF CALIFORNIA, SAN JOSE DIVISION

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5   IN RE: HIGH-TECH EMPLOYEE   )

6   ANTITRUST LITIGATION   ) No. 11-CV-2509-LHK

7   --------------------------

8

9   HIGHLY CONFIDENTIAL

10

11   VIDEOTAPED DEPOSITION OF EDWARD LEAMER

12   San Francisco, California

13   Friday, October 26, 2012

14   Volume I

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18

19

20   Reported by:

21   ASHLEY SOEVYN

22   CSR No. 12019

23   Job No. 1545691

24

25   PAGES 1 - 476

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1	Exhibit 3?	08:12:33
2	A. I think the answer is no.	08:12:40
3	Q. Have you read any portions of any of the	08:12:42
4	plaintiffs' depositions?	08:12:45
5	A. No, I have not.	08:12:46
6	Q. If you could look please at the list of	08:12:54
7	documents you relied upon beginning at page 7 of	08:12:57
8	your Exhibit 3? This is a list of all documents you	08:13:01
9	relied upon?	08:13:08
10	A. That's correct.	08:13:09
11	Q. This is not the entire documentary record	08:13:12
12	in the case, you're aware of that, correct?	08:13:14
13	A. Yes.	08:13:17
14	Q. And who selected these documents for you?	08:13:17
15	A. Well, that was partly the Econ One team,	08:13:19
16	and I suppose the lawyers must have been involved in	08:13:22
17	it as well. Although, that wasn't -- these were not	08:13:25
18	provided to me by the attorneys.	08:13:27
19	Q. But they had a role in selecting it?	08:13:32
20	MR. GLACKIN: Objection, foundation.	08:13:35
21	THE WITNESS: I don't know.	08:13:37
22	BY MR. PICKETT:	08:13:39
23	Q. So you don't know who came up with these	08:13:39
24	documents; is that your testimony?	08:13:41
25	MR. GLACKIN: Objection, vague.	08:13:44

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1	and vague.	08:15:38
2	BY MR. PICKETT:	08:15:40
3	Q. Go ahead.	08:15:40
4	A. I was provided documents by Econ One,	08:15:41
5	documents that I assume they found by -- according	08:15:45
6	to my instruction. And that's the extent to which I	08:15:48
7	received the documents from the case, except I may	08:15:52
8	have had the pleadings, if I remember correctly,	08:15:56
9	directly from the attorney early on.	08:15:59
10	Q. Thank you. Did you talk with any of the	08:16:01
11	plaintiffs?	08:16:05
12	A. No, I did not.	08:16:06
13	Q. Let me ask you, please, to turn to	08:16:14
14	paragraph 10 of your report. Paragraph 10 states	08:16:15
15	the two questions that you were asked to analyze,	08:16:38
16	correct?	08:16:41
17	A. That's correct.	08:16:41
18	Q. And who asked you to analyze those?	08:16:42
19	A. The attorneys provide me these questions.	08:16:45
20	Q. Which ones?	08:16:49
21	A. Well, I think Brendan Glackin may have been	08:16:50
22	the source of this, but I'm not sure that he is the	08:16:51
23	one who really has it specifically. I think he has	08:16:54
24	his words specifically is --	08:16:56
25	Q. With respect to the first question, which	08:16:58

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1	a "yes" or "no."	08:29:56
2	MR. GLACKIN: He's trying to answer your	08:29:57
3	question, Mr. Pickett, okay.	08:29:58
4	MR. PICKETT: I asked a "yes" or "no."	08:29:59
5	Let's move on. We're going to have to go a second	08:30:01
6	day if this keeps going on like this.	08:30:05
7	Q. Let's go back and let me see if I can get a	08:30:08
8	clean record on a simple question. What --	08:30:11
9	(Cross-talking.)	08:30:14
10	A. Could you ask -- (Cross-talking.)	08:30:14
11	Q. What word -- (Cross-talking.)	08:30:14
12	A. Could you please ask a clearer question?	08:30:14
13	The clearer question is -- (Cross-talking.)	08:30:16
14	Q. No -- (Cross-talking.)	08:30:17
15	A. Do facts trump theory always? The --	08:30:17
16	answer to that question is no. So the answer to the	08:30:20
17	question do fact sometimes trump theory? The answer	08:30:24
18	is yes. So please tell me which question you have	08:30:28
19	in mind, and I'll answer "yes" or "no."	08:30:30
20	Q. In your expert opinion, Dr. Leamer, what	08:30:33
21	percentage are you confident class members were	08:30:36
22	undercompensated?	08:30:40
23	A. I -- I -- I reply the same way that I	08:30:45
24	replied before, which is my opinion is that most	08:30:48
25	members of each class were undercompensated.	08:30:50

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1	Q. And what percentage is most?	08:30:53
2	MR. GLACKIN: Objection, asked and	08:30:54
3	answered.	08:30:57
4	THE WITNESS: That suggests a precision	08:30:57
5	which this evidence does not allow.	08:31:00
6	BY MR. PICKETT:	08:31:03
7	Q. Give me a range?	08:31:03
8	MR. GLACKIN: Objection, asked and	08:31:04
9	answered.	08:31:04
10	THE WITNESS: Greater than 50 percent.	08:31:04
11	BY MR. PICKETT:	08:31:07
12	Q. Thank you. Move on to a newer topic.	08:31:07
13	Do you agree that each of the seven	08:31:14
14	defendants compete in one or more labor markets that	08:31:15
15	are far broader than the total seven companies?	08:31:20
16	A. Well, you know, we're going to get in	08:31:25
17	trouble with words all the time. I would definitely	08:31:28
18	agree that they hire employees, not just from some	08:31:30
19	defendants, but much more broadly.	08:31:34
20	Q. Do you know how big the labor pool is for	08:31:42
21	each of the seven defendants?	08:31:47
22	A. I have a rough idea.	08:31:50
23	Q. What is that?	08:31:51
24	A. I have a rough idea in terms of the amount	08:31:52
25	of interdefendant movement has occurred versus the	08:31:55

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1   material consideration in talking about the impact   08:42:58

2   of cold calling. I've studied equations that had   08:43:00

3   the education variables included. But I think it   08:43:04

4   was Google, we lacked education data from several of   08:43:08

5   the defendants, and therefore, we decided to exclude   08:43:12

6   it. That's an example of -- of additional   08:43:15

7   information that would be needed in order to do an   08:43:17

8   individual by individual damage analysis, which by   08:43:22

9   the way, I was not instructed to do.   08:43:25

10   Q.   Does your wage suppression regression   08:43:27

11   analysis allow you to figure out which individual   08:43:29

12   class members were not -- were not harmed and which   08:43:32

13   were the most category we went through earlier were   08:43:36

14   harmed?   08:43:40

15   A.   That's a repeat of what I just said. If   08:43:41

16   you want to talk on an individual by individual   08:43:43

17   basis, you've got to set up this equation so that   08:43:45

18   you include almost all the reasons why people are   08:43:49

19   different. And the most obvious thing that is not   08:43:53

20   in there is the education variable. So had I been   08:43:58

21   asked to formulate an individual by individual   08:44:01

22   estimate, I would have -- I supposed would put a   08:44:04

23   subset of defendants for which I had the education   08:44:07

24   variable, and I don't know what I would do with the   08:44:11

25   rest. But that was not my task.   08:44:13

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1	non-defendants.	08:51:23
2	In fact, the defendants could have -- were	08:51:24
3	allowed by these agreements to do cold calling	08:51:26
4	relative to the non-defendants.	08:51:31
5	Q. And within each other in many instances,	08:51:31
6	right?	08:51:35
7	A. You mean within each other, but not	08:51:35
8	violating their bilateral agreements.	08:51:39
9	Q. Right. Correct?	08:51:41
10	A. That's correct.	08:51:43
11	Q. And you don't have any data as to whether	08:51:44
12	the frequency of the cold calling increased or	08:51:46
13	decreased, do you?	08:51:49
14	A. Well -- (Cross-talking.)	08:51:49
15	MR. GLACKIN: Objection, vague, and asked	08:51:50
16	and answered.	08:51:51
17	THE WITNESS: We really wanted that,	08:51:52
18	obviously, because that could have been extremely	08:51:54
19	useful. But the defendants have not produced useful	08:51:56
20	data with regard to cold calling frequencies.	08:52:01
21	BY MR. PICKETT:	08:52:04
22	Q. And you don't know if a by -- bilateral	08:52:04
23	agreement there was no ability to cold call into a	08:52:06
24	particular company if the employer just cold called	08:52:09
25	somebody else?	08:52:12

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1	MR. GLACKIN: Objection, vague.	08:52:12
2	THE WITNESS: I said I don't have	08:52:16
3	information about the intensity of cold calling	08:52:17
4	either during their conspiracy period, before it or	08:52:20
5	after it.	08:52:24
6	BY MR. PICKETT:	08:52:25
7	Q. So you don't know whether the overall cold	08:52:25
8	calling within any of the labor markets -- one of	08:52:27
9	the defendants is involved, increased, decreased, or	08:52:32
10	stayed the same?	08:52:36
11	MR. GLACKIN: Objection, vague.	08:52:39
12	THE WITNESS: I indicated that we don't	08:52:40
13	have that cold calling information. We very much	08:52:41
14	wanted it, but we don't have it.	08:52:43
15	BY MR. PICKETT:	08:52:46
16	Q. Do you have any information that indicates	08:52:46
17	whether the level of hiring that consummated hiring,	08:52:46
18	as you put it, for any of the seven defendants	08:52:50
19	increased or decreased as a result of the alleged	08:52:53
20	bilateral agreements?	08:52:58
21	A. Well, I -- we have the hiring information,	08:53:01
22	but I made no attempt to estimate a model that you	08:53:04
23	would allow me to answer that question. That was	08:53:09
24	not my task.	08:53:11
25	Q. So as far as you know, the levels of hiring	08:53:13

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1	complexity of it.	08:54:20
2	So just so we are as clear as possible with	08:54:21
3	regard to this answer, I've got these initial two	08:54:24
4	conceptual frameworks which are price discovery and	08:54:29
5	profit sharing. Those things can be different for	08:54:32
6	animators and different from software coders.	08:54:35
7	There's no sense in which -- at that phase, I made	08:54:40
8	a distinction between those two individuals.	08:54:43
9	But then those individuals that are all	08:54:46
10	tied together into -- into a boat that sinks or it	08:54:49
11	doesn't through the internal sharing -- internal	08:54:53
12	equity considerations. So I did not feel it was	08:54:57
13	essential for me to explore the price discovery	08:55:02
14	process for each and every one of the potential	08:55:08
15	skill sets that these firms might be hiring.	08:55:11
16	BY MR. PICKETT:	08:55:18
17	Q. So didn't look at relevant -- you didn't	08:55:18
18	think a labor market for an animator, a labor market	08:55:18
19	for a software coder was relevant to your	08:55:23
20	analysis?	08:55:26
21	A. Well, the regression analysis speaks to	08:55:27
22	that point -- I argue that -- anyway, animators, the	08:55:29
23	software coders all of who -- and on and on, I don't	08:55:31
24	know who specifically are going to have their wages	08:55:36
25	suppressed by this anti-cold calling agreement in	08:55:39

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1   order to know who -- what might have been affected.   08:55:42

2   In that sense, you would have to have record of cold   08:55:46

3   calls not made, and we don't have that.   08:55:49

4   So what instead we did is -- well, not   08:55:52

5   instead, we -- having identified the potential of   08:55:54

6   differential impacts depending upon skill sets, and   08:56:01

7   the three frameworks says these guys are all tied   08:56:04

8   together through their internal equity   08:56:07

9   considerations. And this thing is spread across   08:56:10

10   everybody in the firm. So in a sense, the market is   08:56:14

11   collectively for everybody.   08:56:17

12   Q.   So the regression -- your regression   08:56:18

13   analysis on wage suppression answers all of that,   08:56:19

14   all of those issues?   08:56:23

15   A.   It speaks to all those issues, yeah.   08:56:25

16   Q.   And your regression -- wage suppression   08:56:27

17   regression analysis can answer on the question   08:56:30

18   whether a sous chef at Intel's wages were suppressed   08:56:33

19   during the class period?   08:56:37

20   A.   No, they're not. I've already told you   08:56:38

21   that. It's intended to estimate the conversation   08:56:40

22   suppression by defendant, by year. And carrying   08:56:44

23   that out, I used as much individual information as I   08:56:49

24   had really, which is the age and -- but the model is   08:56:53

25   not intended to give you an estimate of how the   08:56:59

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1   damages varied with age, but instead to control for   08:57:01

2   any composition differences between the firms so   08:57:05

3   that you get as accurate as possible an estimate of   08:57:08

4   the firm by firm effect year by year.   08:57:11

5   Q.   But if you look at individual class   08:57:14

6   members, like this sous chef, your regression   08:57:15

7   analysis cannot tell whether there was any   08:57:17

8   suppression of wages for that individual, correct?   08:57:23

9   MR. GLACKIN: Objection.   08:57:25

10   THE WITNESS: That's correct.   That was not   08:57:26

11   part of the task that I was assigned.   08:57:27

12   BY MR. PICKETT: 08:57:37

13   Q.   In a competitive market, what does it imply   08:57:37

14   about two products or services if one is able to   08:57:41

15   command double of the price?   08:57:44

16   A.   Now, are you talking about facts now or   08:57:46

17   theory?   08:57:48

18   Q.   Theory.   08:57:48

19   A.   From a conceptual framework, so can you be   08:57:48

20   clear to me what the -- what the -- what do you mean   08:57:52

21   by a competitive model, you mean a simple supply and   08:57:55

22   demand model?   08:57:58

23   Q.   Sure.   08:58:00

24   A.   So can you repeat your question again?   08:58:00

25   Q.   In a competitive market, what does it imply   08:58:01

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1	that the key rivals of the seven defendants were	09:00:44
2	only the other six defendants?	09:00:47
3	A. No, it's not.	09:00:48
4	Q. So was it your testimony the key rivals	09:00:50
5	weren't poaching defendants' employees during the	09:00:52
6	class period?	09:00:54
7	A. No, that is not my testimony.	09:00:56
8	Q. Because you know they were, correct?	09:00:59
9	A. Well, this is a reference to the poaching	09:01:04
10	that was not done, not a reference to the poaching	09:01:06
11	that was done.	09:01:10
12	Q. But I'm asking you about the poaching that	09:01:10
13	was done. You know that lots and lots and lots of	09:01:12
14	non-defendants were poaching from these seven	09:01:16
15	defendants, correct --	09:01:19
16	MR. GLACKIN: Objection, vague.	09:01:20
17	BY MR. PICKETT:	09:01:21
18	Q. -- during the class period?	09:01:21
19	MR. GLACKIN: Sorry, I did not mean to	09:01:23
20	interrupt you.	09:01:26
21	THE WITNESS: That's correct.	09:01:26
22	BY MR. PICKETT:	09:01:27
23	Q. And you know that there was some poaching	09:01:27
24	going on among the seven defendants, correct?	09:01:29
25	A. That's correct.	09:01:31

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1   Q.   And did you look at the -- did you look at   09:01:34

2   any quantification of those two factors?   09:01:38

3   A.   Well, again, we can bring up the Google   09:01:43

4   cases. That's a case where a single rival,   09:01:45

5   Facebook, forced Google to make an across-the-board   09:01:48

6   increase in compensation. That is what this is   09:01:53

7   talking about.   09:01:56

8   Q.   We're talking about during the class   09:01:57

9   period -- poaching during the class period. So did   09:01:58

10   you look at either non-defendants or intradefendant   09:02:00

11   poaching during the class period?   09:02:03

12   A.   I looked at the transfers of individuals   09:02:09

13   between the defendants, and I looked at the amount   09:02:13

14   of hiring that was done as we discussed before.   09:02:16

15   Q.   Was Facebook poaching during the class   09:02:26

16   period?   09:02:30

17   A.   I am not -- I don't have privy to that   09:02:32

18   information.   09:02:37

19   Q.   You agree that the defendants were more   09:02:38

20   likely to recruit from product market competitors?   09:02:40

21   A.   This is -- again, is something I have not   09:02:55

22   studied. But they are interested in certain skill   09:02:56

23   mixes. They want to hire skill mixes appropriate to   09:02:59

24   the business. And by that statement, you're saying   09:03:03

25   that the firms that have the right skill mixes are   09:03:05

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1   in the same products, I would agree. But you have   09:03:07

2   to make sure you're defining product narrowly. So,   09:03:10

3   in effect, you're really talking about the skill   09:03:13

4   mixes, not the products.   09:03:13

5   Q.   And product market competitors are more   09:03:16

6   likely to recruit from them, correct, works both   09:03:20

7   ways?   09:03:23

8   A.   I did not get the both ways. What was   09:03:24

9   the --   09:03:25

10   Q.   We just established that defendants are   09:03:25

11   more likely to recruit from product market   09:03:27

12   competitors who have similar skill set employees?   09:03:30

13   A.   Well, I was making a general statement, not 09:03:34

14   with regard to specific defendants. But saying   09:03:36

15   that, generally speaking, you expect employers to be   09:03:39

16   seeking certain skill sets, and if they are going to   09:03:42

17   look at other firms, they are trying to find the   09:03:45

18   skill sets that are similar to the ones they are   09:03:48

19   looking for. And it could well be that similar in   09:03:48

20   the product market is a driver, but I would not   09:03:52

21   think that was a determinant.   09:03:54

22   MR. PICKETT: Let's mark as Exhibit 84 a -- 09:03:55

23   no Bates number -- a document -- I'm sorry, it does   09:04:02

24   have a Bates number. It's GOOG HIGH-TECH 00055116.   09:04:16

25   (Exhibit 84 marked for identification.)   09:04:20

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1	fact, a long tail of companies and organizations who	09:20:39
2	compete with Google to hire the best talent. So	09:20:43
3	obviously, Google is looking around to hire	09:20:46
4	talent.	09:20:49
5	Q. So is it your testimony that you do not	09:20:59
6	know who Google's main competitors for talent are?	09:21:01
7	A. I think my testimony is clear, which is a	09:21:04
8	connection between this first column and Google is	09:21:06
9	not established by this document.	09:21:10
10	Q. Who are Google's main competitors for	09:21:12
11	talent during the class period?	09:21:14
12	A. I -- I don't know.	09:21:16
13	Q. Do you know the main competitors for talent	09:21:17
14	for any of the other six defendants during the class	09:21:19
15	period?	09:21:24
16	A. I know they -- I know the word "competition	09:21:25
17	for talent" is unclear to me, but I know the	09:21:26
18	movement of the individuals between the defendants.	09:21:28
19	That's the -- that's the extent in which we have	09:21:30
20	information on any defendant moves. We don't know	09:21:33
21	who they are cold calling. We don't know moves that	09:21:37
22	are coming from nondefendants to defendants. We	09:21:40
23	don't know where the losses are going from a	09:21:41
24	defendant to a nondefendant. We just know that they	09:21:43
25	are no longer in the database.	09:21:47

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1	Q. And you don't know who the main -- what the	09:21:48
2	main sources for hiring or cold calling was for any	09:21:50
3	of the seven defendants during the class period,	09:21:54
4	correct?	09:21:56
5	A. That's correct.	09:21:58
6	Q. May I ask you to you turn to footnote 111	09:22:01
7	on page 33 of your report. Would it be relevant to	09:22:08
8	your opinion to know who the main sources for hiring	09:22:20
9	or cold calling were for any of the seven defendants	09:22:23
10	during the class period?	09:22:24
11	A. Well, the idea data set would be a complete	09:22:25
12	recording of all the cold calling that was going on,	09:22:28
13	not just among the defendants, but among a whole set	09:22:30
14	of competitors who are in this industry, this	09:22:34
15	high-tech industry.	09:22:37
16	Q. Well, cold calling --	09:22:39
17	A. And that could be -- that could be very	09:22:39
18	useful.	09:22:40
19	Q. Both cold calling and hiring, right?	09:22:41
20	A. Both cold calling and hiring. We had the	09:22:43
21	hiring for the defendants, but as I've already	09:22:45
22	indicated that that's a record that doesn't indicate	09:22:48
23	where the people came from or where they are going,	09:22:50
24	except to the extent that we've been -- done the	09:22:53
25	linkage via the Social Security number to	09:22:55

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1	top competitors for talent who are not defendants in	09:30:15
2	the case, correct?	09:30:18
3	A. That's correct.	09:30:18
4	Q. And you see from the totals that the vast	09:30:25
5	majority of talent acquired and talent lost	09:30:27
6	voluntarily was from nondefendants, correct?	09:30:28
7	MR. GLACKIN: Objection, vague.	09:30:33
8	Mischaracterizes.	09:30:34
9	THE WITNESS: I'd have to compute the	09:30:40
10	numbers exactly, but it appears as though what he	09:30:41
11	said is correct.	09:30:44
12	BY MR. PICKETT:	09:30:46
13	Q. And you agree that even though Google is a	09:30:46
14	defendant, there was no alleged bilateral agreement	09:30:48
15	between Google and Adobe at this point, right?	09:30:52
16	A. That's -- that's my understanding, yes.	09:30:54
17	Q. So -- so no impact under your analysis,	09:30:58
18	correct?	09:30:59
19	MR. GLACKIN: Objection, vague.	09:30:59
20	THE WITNESS: I don't agree with that last	09:31:04
21	sentence that you said.	09:31:05
22	BY MR. PICKETT:	09:31:10
23	Q. Why not?	09:31:10
24	A. The regression estimate that I have relies	09:31:14
25	first and foremost on that kind of variable that is	09:31:19

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1   A.   That's correct.   09:32:39

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1   Q.   You were wrong, weren't you?   09:35:38

2   A.   I misspoke.   09:35:38

3   Q.   So let me ask you to look at the data you   09:35:39

4   do have that you cited in your own report. And,   09:35:41

5   once again, the number of talent acquired and talent   09:35:43

6   lost, the vast majority comes from nondefendants,   09:35:47

7   correct?   09:35:51

8   MR. GLACKIN: Objection, vague.   09:35:55

9   THE WITNESS: The majority definitely   09:35:57

10   does.   09:35:59

11   BY MR. PICKETT: 09:36:01

12   Q.   And there was information flow and price   09:36:01

13   discovery resulting from all of those hires and   09:36:04

14   losses, correct?   09:36:08

15   A.   That's correct.   09:36:09

16   Q.   And all of the cold calls that might have   09:36:09

17   been associated with those, correct?   09:36:12

18   A.   That's correct.   09:36:14

19   Q.   And there was information flow between   09:36:17

20   Apple and Adobe during this period, despite the   09:36:20

21   bilateral agreement, correct?   09:36:24

22   MR. GLACKIN: Objection, foundation.   09:36:25

23   THE WITNESS: You made a reference to the   09:36:27

24   firms, that there was information flowing between   09:36:29

25   the firms.   09:36:31

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1	BY MR. PICKETT:	09:36:32
2	Q. Between the employees -- between the	09:36:32
3	employees and potential employees?	09:36:34
4	A. Well, I'm only making a point that the	09:36:36
5	amount of information flow was suppressed. I'm not	09:36:39
6	saying there was no information flow.	09:36:42
7	Q. How much information was suppressed between	09:36:46
8	Apple and Adobe?	09:36:50
9	A. Well, that would require a data set that I	09:36:52
10	don't have. I already indicated, I don't have the	09:36:56
11	cold calling agreements. I don't have the -- I	09:36:57
12	don't have the information on all the cold calling	09:37:02
13	that was made and all the cold calling that was not	09:37:04
14	made as a consequence of the agreement. And	09:37:05
15	secondly, to translate that into some measure of	09:37:11
16	information is going to be very difficult. It's no	09:37:11
17	simple thing that you can do. So you need to carry	09:37:12
18	out an econometric exercise to answer that question.	09:37:14
19	And I haven't had a database that would allow me to	09:37:18
20	do it. But I have indirectly done it through that	09:37:20
21	damage model because I tell you that before or	09:37:23
22	after, during comparisons, that tells you the impact	09:37:25
23	of these agreements.	09:37:30
24	Q. Your regression analysis?	09:37:32
25	A. The regression, yeah.	09:37:33

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1	Q. Well --	09:42:50
2	A. -- if that's what you mean by	09:42:50
3	"competitive," I will agree.	09:42:52
4	Q. You look to your talent competitors to see	09:42:54
5	what they're paying and you want to make sure your	09:42:56
6	compensation relative to them is competitive,	09:42:58
7	correct?	09:43:00
8	A. Yeah, actually, only to the extent that	09:43:02
9	there's a competitive force. You don't want to	09:43:04
10	match some high salary. Some firm that has --	09:43:07
11	offers high salary, if you are not feeling a	09:43:09
12	competitive force from them.	09:43:14
13	Q. Let me ask you to focus on what we'll call	09:43:16
14	the "but for world," and that's a world in which the	09:43:19
15	alleged bilateral agreements did not exist during	09:43:23
16	the class period. You understand the concept?	09:43:26
17	A. I do.	09:43:29
18	Q. All right. In the "but for world," would	09:43:32
19	there have been more cold calling over all?	09:43:34
20	A. I -- I don't have any evidence or data that	09:43:43
21	would support that conclusion, so --	09:43:46
22	Q. So, go ahead.	09:43:51
23	A. Well, I'll leave it at what I said.	09:43:54
24	Q. So the cold calling would have been	09:43:57
25	redistributed in a "but for world"?	09:43:59

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1	THE WITNESS: Well, the data analysis I	09:46:48
2	carried out, of course, has to target compensation,	09:46:50
3	so I'm asking what would have happened in a "but for	09:46:54
4	world" regarding compensation determination. And	09:46:56
5	I've controlled for a bunch of other variables in	09:46:58
6	this equation, and -- but I've made no attempt to	09:47:01
7	determine the impact of cold calling on anything,	09:47:05
8	except for the compensation.	09:47:06
9	BY MR. PICKETT:	09:47:10
10	Q. Would the total number of hires by each of	09:47:10
11	the defendants in the class period been the same in	09:47:13
12	the "but for world"?	09:47:15
13	MR. GLACKIN: Objection, vague.	09:47:19
14	THE WITNESS: That isn't something that	09:47:27
15	I've explored.	09:47:29
16	BY MR. PICKETT:	09:47:30
17	Q. So you don't know, correct?	09:47:30
18	A. That's correct.	09:47:31
24	A. Okay.	09:47:58
25	Q. So presumably this would -- process would	09:47:59

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 1   came, obviously her salary was not raised            09:56:17

 2   immediately.  So what we're talking about is the     09:56:21

 3   process by which her salary is going to be adjusted  09:56:23

 4   upward as a consequence of the cold call.  And I've  09:56:26

 5   given you already two routes by which this could     09:56:29

 6   occur.                                               09:56:32

 7   BY MR. PICKETT:                                      09:56:32

 8       Q.   Both -- I agree.  And I'm following up on   09:56:32

 9   that by suggesting that it's a subsequent, a later   09:56:35

10   activity by either her or her employer that would   09:56:38

11   impact her.                                          09:56:41

12       A.   Well, I --                                  09:56:42

13       Q.   There's no impact at the point that Adobe   09:56:42

14   says, "No, you can't -- we're not going to agree to  09:56:44

15   renegotiate your salary."                            09:56:48

16       A.   Well, the same thing is true when the phone 09:56:50

17   rings, that's not when the impact -- that's -- a     09:56:52

18   salary increase isn't going to occur when the phone  09:56:55

19   rings, there has to be a sequence of steps that give 09:56:57

20   rise to this higher compensation.                    09:57:00

21       Q.   And how long does this process take in the  09:57:03

22   "but for world"?                                     09:57:05

23       A.   Well, this is one of the cases where I      09:57:08

24   don't have any specific evidence with regard to      09:57:10

25   that, and I rely on my conduct analysis, the         09:57:12
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1	regression analysis, to answer that question	09:57:15
2	indirectly.	09:57:18
3	Q. Okay. How so?	09:57:19
4	A. Because the -- the defendants have gotten	09:57:21
5	together to slow the information flow about outside	09:57:26
6	opportunities in a specific period of time. That's	09:57:29
7	the conduct variable. So then you're trying to find	09:57:31
8	out control for other things that are going on, in	09:57:34
9	what way was compensation different during that	09:57:37
10	period that these agreements were in place. So	09:57:44
11	underlying that is the whole process of information	09:57:44
12	gathering, what impact that has on compensation.	09:57:49
13	Q. Going back to the "but for" hypothetical.	09:57:53
14	How long would -- and if you don't know precisely or	09:57:55
15	can you give me a range, how long would the process	09:57:57
16	take in order to have some kind of impact?	09:58:00
17	MR. GLACKIN: Objection, vague and	09:58:03
18	incomplete hypothetical.	09:58:04
19	THE WITNESS: Well, this is, again, the	09:58:05
20	same answer which is, early on I was imagining that	09:58:07
21	we would have career paths of each individual and	09:58:10
22	information about who was cold called when, and you	09:58:14
23	can build up a sort of story that -- or econometric	09:58:18
24	model that would underline the sequence of questions	09:58:21
25	that you'd ask. But because we don't have that	09:58:27

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1	A. I would -- I would agree there's other cold	10:03:08
2	call.	10:03:10
3	Q. And each of the other defendants would be	10:03:10
4	cold calling into Adobe, correct?	10:03:15
5	A. The ones that had no -- yeah, that's true.	10:03:17
6	Yes.	10:03:20
7	Q. Right. So Adobe employees are getting all	10:03:21
8	kinds of cold calls during the class period,	10:03:24
9	correct?	10:03:27
10	MR. GLACKIN: Objection, vague.	10:03:28
11	THE WITNESS: I would say the conduits are	10:03:29
12	open, not closed. But how many cold calls they get,	10:03:31
13	I don't know --	10:03:35
14	BY MR. PICKETT:	10:03:36
15	Q. Well --	10:03:36
16	A. -- because we don't have that	10:03:36
17	information.	10:03:36
24	Q. Yes or no?	10:03:51
25	A. It's because of the importance of that	10:03:52

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1	occurring.	10:05:43
2	BY MR. PICKETT:	10:05:44
3	Q. And the process of price discovery and	10:05:44
4	internal equity was going on each and every day at	10:05:50
5	Adobe throughout the class period, wasn't it?	10:05:53
6	A. That's correct.	10:05:56
7	Q. And -- and that's true of every call from	10:05:56
8	each one of these other companies that would have	10:06:01
9	been calling in to Adobe employees, right?	10:06:04
10	A. Those calls all play a role in the price of	10:06:07
11	discovery, that's correct.	10:06:11
12	Q. So there's lots of price discovery going	10:06:12
13	on --	10:06:14
14	MR. GLACKIN: Objection.	10:06:15
15	THE WITNESS: -- of each of the seven	10:06:15
16	defendants.	10:06:17
17	MR. GLACKIN: Sorry. Objection,	10:06:17
18	mischaracterizes, vague, argumentative.	10:06:18
19	BY MR. PICKETT:	10:06:20
20	Q. During the class period.	10:06:20
21	A. Well, I think what you're trying to say is	10:06:22
22	that the absence of these cold calls would not have	10:06:25
23	had a material impact on the price of the discovery	10:06:29
24	process, and that's not a valid conclusion.	10:06:31
25	Q. It's a drop in the bucket, isn't it?	10:06:34

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1	Q. I'm trying to focus in on the information	10:10:15
2	flow that comes from, for example, cold calls from	10:10:16
3	companies outside the bilateral agreements. And I	10:10:16
4	asked you whether there were any significant changes	10:10:16
5	in the quality or quantity of those information	10:10:16
6	flows during the class period.	10:10:16
7	A. And I told you it would be great if we had	10:10:16
8	that data set, because we could then study the --	10:10:16
9	the price discovery process in a very interesting	10:10:16
10	way, but we don't have that data set.	10:10:16
11	Q. Okay. And -- and so, you don't know if a	10:10:16
12	small change in information from firms outside the	10:10:16
13	bilateral agreements would have had a large impact	10:10:16
14	or not on the market, correct?	10:10:16
15	A. Well, this issue is being controlled for --	10:10:16
16	by the multiple regression analysis.	10:10:16
17	Q. Did you control, in your regression	10:10:16
18	analysis, for other cold calls from outside firms?	10:11:13
19	A. To the extent that those other cold calls	10:11:17
20	are correlated without any or even one or many of	10:11:20
21	the control variables, the answer is yes. So you'd	10:11:24
22	have to --	10:11:25
23	Q. What -- what variables?	10:11:27
24	MR. GLACKIN: You're interrupting him.	10:11:28
25	Please finish your answer.	10:11:29

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1	this water cooler talk about, "Oh, I had this offer	10:20:35
2	from Apple. And, boy, did I get a great new package	10:20:38
3	with this big increase in my stock options." That	10:20:44
4	kind of stuff is going to go on at the water -- at	10:20:47
5	the water cooler and it's going to be a response to	10:20:48
6	other employees.	10:20:49
7	Q. Is it your view that in the "but for	10:20:51
8	world," an increase in compensation to a single	10:20:54
9	employee would trigger a higher level of	10:20:57
10	compensation for all employees?	10:21:02
11	A. It could. I wouldn't say "would." It	10:21:03
12	could. It depends upon the -- how much information	10:21:06
13	is revealed by that possibility.	10:21:10
14	Q. And what level of compensation increase	10:21:11
15	would this single employee need to obtain, in order	10:21:14
16	for it to impact the level of compensation for all	10:21:17
17	employees?	10:21:20
18	A. I don't have a specific number in mind.	10:21:22
19	Q. How could a single employee's higher	10:21:25
20	compensation result in an across-the-board change in	10:21:28
21	compensation?	10:21:31
22	A. Maybe I should reveal that I have a little	10:21:33
23	expertise in this because I was the chairman of the	10:21:35
24	economics department at UCLA for a five-year period	10:21:37
25	in the 1980s.	10:21:42

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1	Q. Let me go back to the class period and our	10:53:39
2	Adobe employee that we were talking about. As a	10:53:43
3	result of the bilateral agreement with Apple, let me	10:53:47
4	ask you to assume that the Adobe employee in the	10:53:51
5	real world with existence of bilateral agreements	10:53:55
6	that you found, does not get a cold call from Apple	10:53:56
7	and does not get hired by Apple as a result of not	10:54:03
8	receiving a cold call. Are you with me so far?	10:54:07
9	A. Yes.	10:54:10
10	Q. All right. So instead, Apple not being	10:54:10
11	able to cold call, the Adobe employee contacts	10:54:13
12	somebody at Microsoft and hires that person at	10:54:16
13	Microsoft. That's a logical scenario, is it not?	10:54:19
14	A. It's a possibility.	10:54:24
15	Q. That job wouldn't stay empty for years and	10:54:25
16	years just because there's no ability to call one	10:54:30
17	company, right?	10:54:33
18	A. Yeah, we talked about this before, of	10:54:33
19	course.	10:54:35
20	Q. So if that person got hired from Microsoft	10:54:35
21	and hired by Apple -- the Microsoft employee now	10:54:38
22	gets hired by Apple, that person is a member of the	10:54:43
23	class, correct, as an Apple employee?	10:54:47
24	A. Correct.	10:54:49
25	Q. And if the Adobe employee would have gotten	10:54:53

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1	the job, rather than the Microsoft employee, isn't	10:54:56
2	the Microsoft employee benefited by now having this	10:54:58
3	new job at Apple?	10:55:01
4	MR. GLACKIN: Objection, vague.	10:55:05
5	THE WITNESS: Well, this is something that	10:55:15
6	I think needs to be thought out clearly. I hate to	10:55:16
7	wing it with regard to opinion on that. But you	10:55:21
8	raise a possibility.	10:55:23
9	BY MR. PICKETT:	10:55:26
10	Q. Because the Adobe person, under your	10:55:26
11	scenario, was harmed because she did not get the job	10:55:29
12	at Apple, right?	10:55:32
13	A. Well, she -- it's not necessarily the job	10:55:35
14	at Apple, but if there was a job, then she was	10:55:37
15	harmed. But only if she was harmed because she	10:55:41
16	doesn't have knowledge about the opportunities at	10:55:44
17	Apple.	10:55:46
18	Q. All right, but that led to a job if it	10:55:46
19	comes all the way down the road.	10:55:48
20	The person at Microsoft get's a job, and	10:55:49
21	she would not have had, but for the bilateral	10:55:52
22	agreement, why isn't that person benefited from it	10:55:55
23	because she's got a job she wanted?	10:55:57
24	BY MR. PICKETT:	10:56:00
25	A. Well, it's a job with a suppressed level of	10:56:00

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```
 1   compensation because the information flow and the      10:56:03

 2   market place is going to be less.  And the question    10:56:05

 3   is, how much suppressed is that?                       10:56:08

 4       Q.   Right.  You would have to look at the         10:56:12

 5   suppression versus the benefit she received from       10:56:13

 6   moving from Microsoft to Apple, right?                 10:56:16

 7       A.   Yeah, this is something I'd have to           10:56:24

 8   explore.  There's no point in sitting here and         10:56:27

 9   hypothesizing different kinds of models.               10:56:29

10       Q.   You'd have to measure the benefit she got     10:56:32

11   in getting her Apple job versus the lower comp,        10:56:35

12   presumably, but she would not have gotten the job      10:56:40

13   anyway, right?                                         10:56:44

14           MR. GLACKIN:  Objection, compound and          10:56:44

15   vague.                                                 10:56:47

16   BY MR. PICKETT:                                        10:56:49

17       Q.   She wouldn't have gotten the job?  You        10:56:49

18   understand, and I am correct in saying that, under     10:56:51

19   my hypothetical, the Microsoft employee would not      10:56:54

20   have gotten the job, it would have gone to the Adobe   10:56:57

21   person?                                                10:57:00

22       A.   Yeah, that's your assumption.  The question   10:57:00

23   is what does that imply --                             10:57:03

24       Q.   Right, that's a legitimate assumption.        10:57:04

25       A.   -- about the damages.                         10:57:06
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1	Q. That's a legitimate assumption, right?	10:57:08
2	A. That's a -- it's a possibility.	10:57:11
3	Q. And what does it tell you about the damages	10:57:17
4	to that Microsoft employee who is now in the	10:57:19
5	class?	10:57:21
6	A. Like I said before, I understand what	10:57:33
7	you're asking me, but I can't offer a off-the-cuff	10:57:34
8	explanation without thinking through it clearly.	10:57:41
9	Q. As you sit here right now, can you think of	10:57:44
10	any way in which that Microsoft employee is not	10:57:48
11	benefited by getting the new job?	10:57:51
12	MR. GLACKIN: Objection, vague, incomplete	10:57:53
13	hypothetical.	10:57:55
14	THE WITNESS: Well, the suppression of	10:57:56
15	information about the job opportunities is going to	10:57:59
16	be suppressing conversation, not just of the	10:58:03
17	defendants, but elsewhere as well.	10:58:05
18	BY MR. PICKETT:	10:58:08
19	Q. So her Microsoft salary was suppressed?	10:58:08
20	A. It's possible. You've asked me in this	10:58:11
21	hypothetical way in which we could interpret	10:58:14
22	this would lead to --	10:58:19
23	Q. How does it work -- (Cross-talking.)	10:58:22
24	MR. GLACKIN: Are you finished?	10:58:24
25	THE WITNESS: You asked me whether I can	10:58:24

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1	concoct the story of mine in which this hypothetical	10:58:26
2	individual was actually harmed by the -- by the	10:58:27
3	conspiracy, and I'm not -- even though I probably	10:58:27
4	shouldn't, and I gave you an example.	10:58:32
5	BY MR. PICKETT:	10:58:37
6	Q. How would it work that her Microsoft salary	10:58:38
7	would have been impacted?	10:58:42
8	MR. GLACKIN: Objection, incomplete	10:58:47
9	hypothetical, calls for speculation, foundation.	10:58:49
10	THE WITNESS: Well, if we thought of there	10:58:52
11	being a specific skill category, and suppose there's	10:58:54
12	an increase in demand for this skill category, so	10:58:58
13	the new equilibrium price is going to be a higher	10:59:03
14	price.	10:59:08
15	This sequence of transactions in search of	10:59:08
16	that equilibrium and those transactions are	10:59:13
17	occurring among the defendants, but they are	10:59:13
18	occurring with the non-defendants as well. So those	10:59:15
19	Microsoft employees are also being impaired by the	10:59:17
20	information -- by the limited information flow.	10:59:22
21	BY MR. PICKETT:	10:59:25
22	Q. Isn't it the case that the Microsoft	10:59:25
23	employees would be getting more cold calls because	10:59:27
24	of the restrictions on cold calling within the	10:59:30
25	bilateral agreement?	10:59:34

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1	A. Then we come back to their question. How	10:59:35
2	many cold calls are there going to be? I'm	10:59:37
3	proceeding on the assumption that if you can't cold	10:59:41
4	call among these -- with bilateral agreements, the	10:59:43
5	amount of cold calling goes down. Yours is a -- oh,	10:59:46
6	you're astounded by that.	10:59:50
7	Q. Because you testified earlier, sir, just	10:59:52
8	the opposite. That's why I'm astounded.	10:59:53
9	A. I testified it's a possibility, but I don't	10:59:56
10	think that it's likely they have complete	10:59:59
11	substitutability. That seems implausible to me.	11:00:01
12	Q. You don't know one way or the other, do	11:00:04
13	you?	11:00:07
14	MR. GLACKIN: Objection.	11:00:07
15	THE WITNESS: I don't have the data, but I	11:00:08
16	think as an economist, I find it implausible that	11:00:09
17	these ripe fruit that you decided to try to pick off	11:00:13
18	between the defendants are replaceable exactly by	11:00:16
19	the equivalent ripe fruit elsewhere, that seems to	11:00:20
20	me unlikely.	11:00:26
21	BY MR. PICKETT:	11:00:27
22	Q. Do you know if any of the defendants have a	11:00:35
23	set annual budgets for raises?	11:00:37
24	A. They have budgeting processes. I guess	11:00:41
25	that's what you're making reference to. They have	11:00:43

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 1        Q.   So at the department level, some employees    11:02:38

 2   get smaller raises if other employees get larger        11:02:40

 3   raises?                                                  11:02:44

 4        A.   That's correct.  That would be a              11:02:45

 5   consequence of that budget constraint.                  11:02:46

 6        Q.   Okay.  Let's turn to a different topic.        11:02:55

 7   You have looked at two proposed classes in this         11:03:01

 8   case.  You can look at paragraph 8, page 3 of your      11:03:04

 9   report.  How did you determine the scope of the two     11:03:07

10   classes?                                                11:03:19

11        A.   Do you mean the definition of the classes?    11:03:20

12   I was provided these two classes by the attorneys.      11:03:21

13        Q.   Did you suggest any changes?                  11:03:25

14        MR. GLACKIN:  I'm going to instruct the            11:03:32

15   witness that he's not to disclose the contents of       11:03:33

16   any communication with counsel per stipulation in       11:03:37

17   this case.  But aside from that instruction, you        11:03:39

18   should answer.                                          11:03:40

19        THE WITNESS:  I'm sorry, you said I should         11:03:43

20   answer?                                                 11:03:45

21        MR. GLACKIN:  If you can answer it without         11:03:46

22   disclosing communications with counsel, then you can    11:03:47

23   answer.  If the only answer you can give would be to    11:03:49

24   disclose the communication with counsel, then you       11:03:52

25   should not answer.                                      11:03:54
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1	on that issue.	11:13:26
2	BY MR. PICKETT:	11:13:28
3	Q. Did you include employees hired right out	11:13:28
4	of college in the class?	11:13:31
5	A. Yes.	11:13:34
6	Q. So if somebody graduated from Yale in 2006,	11:13:34
7	that person is in the class and was undercompensated	11:13:38
8	in 2006, correct?	11:13:43
9	A. That's correct.	11:13:45
10	Q. How often are college seniors subject to	11:13:46
11	cold calling?	11:13:49
12	A. My impression is they are infrequently	11:13:51
13	subject to cold calling.	11:13:53
14	Q. So they're just swept up by everybody	11:13:54
15	else?	11:13:58
16	A. Well, there is a sharing that they	11:13:59
17	participate in, even though they are not directly	11:14:01
18	being cold called, the internal equity	11:14:04
19	considerations will have them share the	11:14:08
20	undercompensation of -- (Inaudible mumbling.)	11:14:11
21	Q. Why doesn't the market competition for	11:14:13
22	college graduates control the level of their	11:14:15
23	competition?	11:14:19
24	MR. GLACKIN: Objection, assumes facts,	11:14:19
25	vague, and ambiguous.	11:14:20

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1	THE WITNESS: I withdraw my previous	11:14:36
2	comment, which is I agree with the implication,	11:14:37
3	which is that there would be -- at the initial date	11:14:41
4	of hiring, if there's really a market for these	11:14:44
5	individuals, then those individuals might be on,	11:14:49
6	that day, unaffected by the cold calling.	11:14:52
7	But thereafter, as a reel of experience,	11:14:55
8	then the force of initial and so-called market	11:14:59
9	contract becomes less and less.	11:15:02
10	BY MR. PICKETT:	11:15:06
11	Q. So there are thousands of college	11:15:06
12	graduates every year trying to get jobs at Google	11:15:08
13	and Apple and so on, and there are thousands of	11:15:12
14	college graduates being employed throughout the	11:15:14
15	class period. And there's a market for those for	11:15:18
16	transactions, are there not?	11:15:20
17	A. Correct.	11:15:22
18	MR. GLACKIN: Objection, vague, and	11:15:22
19	ambiguous.	11:15:23
20	THE WITNESS: What are you calling a	11:15:24
21	market?	11:15:25
22	BY MR. PICKETT:	11:15:25
23	Q. Pardon?	11:15:25
24	A. Yes, I would -- it may be appropriate to	11:15:26
25	call that a market as well is what I would say.	11:15:28

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1   Q.   And it sets a level of initial compensation   11:15:31

2   that's competitive, true?   11:15:34

3   A.   Well, I haven't studied that specific   11:15:37

4   market, but I agree with the implications of what   11:15:38

5   you're suggesting is that that's more likely to be a   11:15:43

6   competitive market than elsewhere --   11:15:45

7   Q.   And -- (Cross-talking.)   11:15:47

8   A.   -- but to which I want to add in my   11:15:48

9   regression analysis, I allow the age and the square   11:15:50

10   age to have an impact on the undercompensation. And   11:15:53

11   that's meant to pick up these college graduates   11:16:01

12   meaning that the younger kids are going to be less   11:16:06

13   impacted than the older ones.   11:16:06

14   Q.   But why would they be impacted at all? Why   11:16:06

15   wouldn't the competitive market just set a level of   11:16:08

16   compensation for them?   11:16:11

17   A.   Well, I'm going to let the data speak to   11:16:12

18   that by allowing the conduct effect to depend upon   11:16:14

19   the age and age squared. Now --   11:16:17

20   Q.   Why would there be any?   11:16:19

21   MR. GLACKIN: He's not finished. Let him   11:16:20

22   finish his answer.   11:16:20

23   THE WITNESS: If we had additional   11:16:22

24   information on whether they were new college   11:16:23

25   graduates or not, then we can attempt to control for   11:16:25

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1	Q. 67.	11:17:25
2	A. Okay. Yes.	11:17:34
	████ ████ ██████████████████ ██████	████
	██ ████████████████████████████████████ ██████	████
	██ ██████ ████	████
	██ ████ ██████████████ ████	████
7	Q. So the college graduate who applied to a	11:17:43
8	bunch of schools and -- sorry, applied to a bunch of	11:17:45
9	companies and got a particular job, he or she also	11:17:47
10	got ████████████████████	11:17:52
11	A. That's not correct. Meaning that the age	11:17:56
12	variable and the equation allows to you distinguish	11:18:00
13	employees by age. ██████████████ ████	
	██ ██████████████████████ ████	
	██ ████████████████ ████	
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	██ ██████████ ████	
24	MR. GLACKIN: Objection, vague.	11:18:47
25	THE WITNESS: The word "technical employee	11:18:49

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1	formal application, not the sort of more passive	11:39:37
2	description that you've described.	11:39:40
3	BY MR. PICKETT:	11:39:42
4	Q. So you think if I go on the Internet and I	11:39:42
5	tell the world I'm interested in jobs, that I can't	11:39:43
6	be cold called under the terms of these	11:39:47
7	agreements?	11:39:51
8	MR. GLACKIN: Objection, foundation.	11:39:53
9	THE WITNESS: I don't know. I think that's	11:40:05
10	a gray area.	11:40:06
11	BY MR. PICKETT:	11:40:10
12	Q. Well, how did you account for it?	11:40:10
13	A. Well, we're going to come back to	11:40:11
14	regression again. The regression is what it is.	11:40:13
15	Q. Do you think that cold calling was allowed	11:40:16
16	if someone posted a resume on a job board like	11:40:18
17	monster.com?	11:40:23
18	A. I can't remember any comment in the	11:40:25
19	agreements that I saw that would make that clear --	11:40:25
20	make it clear one way or the other.	11:40:28
21	Q. Did you look at how the various agreements	11:40:30
22	were enforced?	11:40:34
23	A. Well, I've looked at various enforcement	11:40:35
24	actions, yes. But I can't remember a single	11:40:37
25	document that raises the question that you raise,	11:40:41

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1	but perhaps I overlooked it.	11:40:44
2	Q. Does it matter to your opinion how broadly	11:40:46
3	or narrowly any of the agreements were interpreted?	11:40:49
4	MR. GLACKIN: Objection, vague.	11:40:53
5	THE WITNESS: Well, again, the regression	11:40:54
6	is what it is, so the answer to that is no.	11:40:55
7	BY MR. PICKETT:	11:40:58
8	Q. Wouldn't it affect the amount of	11:40:58
9	information that was suppressed depending on how	11:41:00
10	these agreements were interpreted?	11:41:04
11	A. It absolutely would.	11:41:06
12	Q. But you haven't measured that, have you?	11:41:07
13	A. Well, we're having the same conversation	11:41:10
14	over and over, which is measuring the information	11:41:12
15	first of all requires you to measure the cold	11:41:14
16	calling and then to transfer the cold calling in	11:41:17
17	some measure of the information flow. That requires	11:41:19
18	some serious econometric work.	11:41:21
19	The first step of which is get the data set	11:41:25
20	together, which we don't have. So then I'm relying	11:41:28
21	on -- the conceptual frameworks indicate the	11:41:30
22	possibilities, and then I turn those possibilities	11:41:34
23	into estimates using the regression analysis.	11:41:36
24	Q. I'm going to ask you to turn, please, to	11:41:48
25	footnote 112, it's on page 33. And the particular	11:41:50

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1             MR. GLACKIN:  Objection, asked and        11:47:04

2    answered.                                          11:47:06

3             THE WITNESS:  Yes, I do.                   11:47:06

4    BY MR. PICKETT:                                    11:47:07

5        Q.   In fact, you say that on paragraph -- in  11:47:07

6    paragraph 68 of your report on page 30, right?     11:47:09

7        A.   Yes, I see that.                          11:47:21

8        Q.   Do you know what else contributes to the  11:47:23

9    information gathering?                             11:47:24

10       A.   Well, people seeking out jobs, we talked  11:47:28

11   about this.  The active candidates seeking out jobs 11:47:30

12   would be a source of information.                  11:47:34

13       Q.   Well, there's all kinds of --             11:47:35

14   (Cross-talking.)                                   11:47:35

15       A.   Postings.                                 11:47:36

16       Q.   There's all kinds of other information,   11:47:38

17   isn't there?                                       11:47:40

18            MR. GLACKIN:  Objection.                   11:47:41

19            THE WITNESS:  If you give me a little bit  11:47:42

20   of time, I would list others.  But cold calling is 11:47:44

21   not the only one, I totally agree with that.  Cold 11:47:46

22   calling can be especially important in certain     11:47:50

23   circumstances.                                     11:47:52

24   BY MR. PICKETT:                                    11:47:54

25       Q.   What other sources of information were    11:47:54
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1	there, apart from cold calling?	11:47:57
2	MR. GLACKIN: Objection, vague.	11:48:01
3	THE WITNESS: There is -- job postings that	11:48:04
4	sometimes will give you a good idea what is	11:48:11
5	available outside. There is general water cooler	11:48:14
6	discussions about how well you're doing at these	11:48:17
7	other firms. There's a long list of additional ways	11:48:21
8	of finding out about the opportunities.	11:48:23
9	BY MR. PICKETT:	11:48:27
10	Q. Can you list as many as possible?	11:48:27
11	A. Could I list as many as possible? Well,	11:48:30
12	there are events at which the employers will be	11:48:45
13	hiring. There are advertisements. There are	11:48:50
14	Internet postings. Those are the ones that come to	11:48:58
15	my mind. There could be others as well.	11:49:03
16	Q. There are surveys on the Internet that post	11:49:07
17	what salaries are, correct?	11:49:09
18	A. That's correct.	11:49:11
19	Q. Apparently, UCLA -- every single salary at	11:49:14
20	UCLA apparently is posted on the Internet, correct?	11:49:16
21	A. That's correct.	11:49:18
22	Q. That information is available to anyone?	11:49:19
23	A. That's correct.	11:49:20
24	Q. And that's true for lots and lots of	11:49:21
25	companies, true?	11:49:23

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1   A.   I don't think it's true for lots and lots.   11:49:24

2   You can have average salaries, but typically,   11:49:26

3   the salary information is considered private.   11:49:27

4   Q.   You can hear about it through college? You   11:49:31

5   can hear about compensation information through   11:49:33

6   college?   11:49:35

7   A.   That's correct.   11:49:39

8   Q.   Correct?   11:49:41

9   A.   That's correct.   11:49:42

10   Q.   What did you do to investigate what amount   11:49:42

11   of information was suppressed through the cold   11:49:45

12   calling restriction versus information that was   11:49:47

13   available through the various other sources?   11:49:49

14   A.   Well, we're back to the same question   11:49:51

15   again. If you had the cold calling data, and   11:49:52

16   ideally if you had this other data as well with   11:49:57

17   regard to postings and advertisement, etc., then   11:50:00

18   it's quite possible that you can unscramble forms of   11:50:02

19   these relative source of information to determine   11:50:05

20   which one is the -- is critical for the price   11:50:08

21   discovery process.   11:50:12

22   But absent the information, I've got to   11:50:13

23   rely on regression equation to determine -- not   11:50:15

24   which one is more important, but how much did   11:50:20

25   cold calling -- how much did anti-cold calling   11:50:23

                                                 Page 190

1	matter.	11:50:25
2	Q. Other than the regression analysis, you	11:50:28
3	hadn't performed any study because you didn't have	11:50:30
4	the data?	11:50:33
5	A. I did not have the data.	11:50:34
6	Q. Does it matter to you whether the	11:50:43
7	significance of cold calling in terms of the	11:50:44
8	information it provides varies by the job position	11:50:47
9	that's affected?	11:50:52
10	A. So does it matter to me? I'm not so	11:50:55
11	sure what you mean.	11:50:57
12	Q. Does it matter to your results and to your	11:50:58
13	opinion?	11:51:01
14	A. It doesn't matter to the results, but the	11:51:01
15	conceptual frameworks implicitly or explicitly allow	11:51:03
16	that as a possibility. So price discovery is not --	11:51:08
17	is going to operate differently for the accountants	11:51:09
18	as it does for the software engineers. The extent	11:51:11
19	to which certain -- certain employee classes have --	11:51:15
20	employee groups have shared equity in the firm,	11:51:19
21	that's going to vary by job title as well. But they	11:51:23
22	are all tied together by glue -- the commonality of	11:51:26
23	being in this family firm, and wages are going to	11:51:29
24	tend to be similar across all these groups.	11:51:32
25	Q. Based on your regression analysis?	11:51:38

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1	does that mean that there is some correlation within	12:13:37
2	a single defendant's employees' compensation?	12:13:44
3	A. I have no idea what you mean by that	12:13:49
4	statement.	12:13:51
5	Q. What do you mean by "somewhat rigid salary	12:13:51
6	structure"?	12:13:54
7	A. That the -- it's expressed by these	12:13:55
8	regressions that describe the compensation as a	12:14:03
9	function of an individual's age, title, education.	12:14:05
10	And the salary structure is described by those	12:14:09
11	equations. And I would call those a "somewhat rigid	12:14:12
12	salary structure."	12:14:16
13	Q. What do you mean by "rigid"?	12:14:17
14	A. Meaning it's persistent. Meaning that if	12:14:19
15	something gets out of -- out of whack, it's going to	12:14:22
16	be brought back into whack in order to restore	12:14:24
17	internal equity. These are curves of internal	12:14:28
18	equity, if you want to put it that way.	12:14:30
19	Q. So there's an internal relationship among	12:14:31
20	the various compensation levels at a single	12:14:34
21	defendant?	12:14:41
22	A. Correct, there are.	12:14:42
23	Q. And you haven't looked at whether there's a	12:14:42
24	relationship or correlation between or among, I	12:14:45
25	should say, the seven defendants, have you?	12:14:48

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1	Q. Ask you to turn to page -- paragraph 64,	12:20:28
2	which is page 29. Well, the part of it I'd like to	12:20:33
3	point you to is on page 29.	12:20:44
4	So in that paragraph you're talking about	12:20:48
5	common proof and "B" states, "Additional evidence	12:20:55
6	that compensation of employees tended to move	12:20:57
7	together over time, such as the effects of	12:21:00
8	noncompete agreements are likely to be broadly	12:21:05
9	felt." Do you see that?	12:21:07
10	A. I do see that.	12:21:08
11	Q. So you felt the need to test whether the	12:21:11
12	compensation of employees tended to move together	12:21:14
13	over time, right?	12:21:18
14	A. Within firms, by the way.	12:21:21
15	Q. You mean on an individual	12:21:25
16	defendant-by-defendant basis?	12:21:27
17	A. Correct.	12:21:29
18	Q. Only that?	12:21:31
19	A. The sharing's about internal equity, it's	12:21:33
20	not about cross-firm consideration. So it's really	12:21:35
21	about what's happening inside the firms.	12:21:39
22	Q. So only that, correct? Only within a	12:21:43
23	single entity?	12:21:53
24	A. Correct. That's a reference. It doesn't	12:21:55
25	mean that there isn't coordination of salary	12:21:57

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 1    structures across firms, but the sharing notion is a      12:22:01

 2    strictly internal notion.                                 12:22:04

 3         Q.   Did you test for coordination over time?        12:22:08

 4         A.   No, because it's not material to the task       12:22:12

 5    that I was assigned to carry out.                         12:22:14

 6         Q.   In looking at whether class member salaries     12:22:16

 7    moved together over time within their single              12:22:18

 8    defendant, that's -- one of the steps -- part of the      12:22:22

 9    second step in your opinion there's classified proof      12:22:28

10    of impact, correct?                                       12:22:31

11         A.   Second part of the --                           12:22:37

12         Q.   Go back to the beginning.  You posited a        12:22:39

13    two-step analysis that we started the deposition          12:22:42

14    with on paragraph 10.  Do you recall paragraph 10?        12:22:46

15    You're looking at it now.                                 12:23:00

16         A.   Yeah, these are the two -- two questions        12:23:00

17    that I was asked to explore.                              12:23:02

18         Q.   All right.  And I think your reasons are        12:23:04

19    the two-steps you need to take to get to your final       12:23:05

20    conclusion, correct?                                      12:23:09

21         MR. GLACKIN:  Objection to                           12:23:09

22    characterization.                                         12:23:10

23         THE WITNESS:  I wouldn't describe them as            12:23:11

24    steps.  They are two components, two tasks that I         12:23:14

25    was asked to carry out.                                   12:23:14
```

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1	was finished.	12:33:07
2	MR. PICKETT: My question wasn't R squared,	12:33:08
3	it was to individual compensation dollars.	12:33:10
4	THE WITNESS: Well, the R squared of 95	12:33:12
5	percent, which is the 2011 -- 2001 result, that's --	12:33:14
6	that's an R squared that explains a significant	12:33:19
7	fraction of the -- of the variability in individual	12:33:23
8	compensation. So I don't know where you're getting	12:33:24
9	at -- what you're getting at with this sequence of	12:33:30
10	questions, but I completely agree that it doesn't	12:33:31
11	explain everything.	12:33:34
12	BY MR. PICKETT:	12:33:35
13	Q. Wouldn't you get --	12:33:35
14	A. Still, I uncovered a structure that tends	12:33:35
15	to be permanent over time.	12:33:37
16	Q. Well, for some individuals you would agree	12:33:39
17	that there's a lot more than 10 percent dispersion	12:33:42
18	of dollars unexplained by your common factors,	12:33:45
19	right?	12:33:49
20	A. Yeah, the residuals on individuals could be	12:33:49
21	bigger than 10 percent of their current	12:33:51
22	compensation.	12:33:53
23	Q. For an individual employee?	12:33:54
24	A. That's correct.	12:33:55
25	Q. And if the R squared was 100 percent, 100	12:33:55

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1	percent in each year, must compensation move	12:33:59
2	together across groups?	12:34:02
3	A. Well, to the extent that's the same	12:34:05
4	coefficients on a year-by-year basis, the answer is	12:34:07
5	yes.	12:34:10
6	Q. Now, do the regressions look at changes in	12:34:13
7	compensation over time?	12:34:17
8	A. No, they do not.	12:34:21
9	Q. You ran the regressions separately year by	12:34:23
10	year, right?	12:34:26
11	A. That's correct.	12:34:26
12	Q. And you didn't attempt to correlate years,	12:34:27
13	correct?	12:34:33
14	A. What's being reported here doesn't make a	12:34:33
15	reference to intertemporal comparisons.	12:34:35
16	Q. And -- and you didn't attempt to correlate	12:34:40
17	between different job titles, did you?	12:34:42
18	MR. GLACKIN: Objection, vague.	12:34:50
19	THE WITNESS: I don't know what you mean by	12:34:58
20	"correlate between different job titles."	12:35:00
21	BY MR. PICKETT:	12:35:03
22	Q. You didn't put in data job title by job	12:35:03
23	title?	12:35:07
24	A. Well, there are title indicators in here,	12:35:07
25	you don't mean that. So what is it that you --	12:35:09

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1	Q. Compensation for job titles.	12:35:14
2	A. But there are title indicators in here, so	12:35:15
3	that's going to absorb everything that's title	12:35:19
4	specific. So the thing about that coefficient on	12:35:21
5	that title indicator, it's going to be likely the	12:35:23
6	average compensation within that title adjusted for	12:35:24
7	these other variables.	12:35:24
8	Q. Are the coefficients in your analysis the	12:35:31
9	same year to year?	12:35:33
10	A. No, they are not.	12:35:35
11	Q. So what conclusion do you draw from that?	12:35:37
12	A. Well, their conclusion is that they're	12:35:40
13	similar.	12:35:43
14	Q. By --	12:35:46
15	A. Similar enough to suggest that there's a	12:35:47
16	fairly rigid salary structure in place on a	12:35:49
17	year-by-year basis.	12:35:52
18	Q. Similar in a statistic -- statistically	12:35:55
19	significant way?	12:35:57
20	A. I have not explored that possibility.	12:35:59
21	Q. Haven't tested that, have you?	12:36:01
22	A. No.	12:36:02
23	Q. So you just eyeballed it?	12:36:03
24	A. I guess that's correct.	12:36:14
25	Q. Now, there is a way to test that, isn't	12:36:18

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1	there?	12:36:20
2	A. You're using the word "testing." The word	12:36:20
3	"statistical testing" is talking about measurability	12:36:24
4	and we're really here about a consequence -- we	12:36:26
5	really should be talking about consequentiality.	12:36:30
6	There are meaningful differences in the wage	12:36:31
7	structures over time. So you're -- you're	12:36:34
8	suggesting I should do a formal hypothesis test	12:36:36
9	using econometric power and accept or reject this	12:36:41
10	idea that there isn't any change. That isn't what I	12:36:43
11	consider relevant. What's relevant is whether the	12:36:43
12	changes are consequential, and the consequential	12:36:50
13	changes that are statistically reliable.	12:36:54
14	So I -- I haven't carried out that	12:36:54
15	exercise, but I would object to what I think would	12:37:00
16	be the target of your hypothesis testing.	12:37:05
17	Q. Let me ask you, please, to look at	12:37:07
18	paragraph 130 on page 55.	12:37:08
19	A. Okay.	12:37:10
20	Q. The third sentence of that paragraph	12:37:10
21	states, "Furthermore, the fact that the coefficients	12:37:12
22	and the regressions did not vary substantially over	12:37:14
23	time, suggests the compensation structures were	12:37:17
24	relatively stable over time."	12:37:20
25	Now, you did not do a statistical test to	12:37:23

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1	draw that conclusion, correct?	12:37:28
2	A. I'm -- I'm -- what paragraph are you	12:37:30
3	referring to?	12:37:31
4	Q. 130.	12:37:32
5	A. Yeah.	12:37:34
6	Q. Third sentence.	12:37:34
7	A. I -- I -- I did not make any formal attempt	12:37:39
8	to determine their instability over time. I used my	12:37:42
9	wisdom to explore the coefficients and came to the	12:37:45
10	conclusion that variability was not consequential.	12:37:53
11	Q. You eye -- you eyeballed it?	12:37:56
12	MR. GLACKIN: I'm sorry, he wasn't	12:37:57
13	finished.	12:37:57
14	THE WITNESS: And that additional test were	12:37:59
15	carried out in this hypothesis testing that you	12:38:01
16	described, unless it's done in a way that deals with	12:38:05
17	consequentiality, it's not going to be informative	12:38:09
18	to the task that I was assigned.	12:38:15
19	BY MR. PICKETT:	12:38:18
20	Q. Right. So -- so you eyeballed them,	12:38:18
21	correct?	12:38:19
22	MR. GLACKIN: Objection.	12:38:19
23	THE WITNESS: I examined the coefficients	12:38:20
24	to see if they were what I regarded to be major	12:38:22
25	changes in the structure over time. And in order to	12:38:26

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1	do that, I used my eyes and my glasses.	12:38:28
2	BY MR. PICKETT:	12:38:34
3	Q. What does "very substantially" mean?	12:38:34
4	A. It's a judgment call about the extent to	12:38:36
5	which this is supportive of the notion that the	12:38:38
6	sharing of conversation across a class.	12:38:41
7	Q. Can you -- can you quantify it?	12:38:47
8	A. Can I quantify it? I could, but I haven't	12:38:52
9	done that.	12:38:54
10	Q. Well, you drew a conclusion when you used	12:38:55
11	your eyes to look at these numbers, and said, "Hmm,	12:39:00
12	they don't vary substantially over time."	12:39:02
13	A. Correct.	12:39:05
14	Q. What -- what parameters were you using?	12:39:06
15	A. Well, you want to look at the age -- let's	12:39:08
16	look at the age variable and see if there's some	12:39:11
17	huge difference. Are we having different kinds of	12:39:14
18	conversation for the age. And I'm looking, flipping	12:39:17
19	through this. And as the age coefficient evolves	12:39:19
20	over time, it stays around one. It evolves up a	12:39:24
21	little bit.	12:39:29
22	Q. Uh-huh. So it goes from 0.7 to 1.25,	12:39:29
23	right?	12:39:36
24	A. Correct. And it's offset by a movement of	12:39:39
25	the squared term as well.	12:39:43

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1	internal salary structures.	12:42:19
2	Q. So is it your opinion that .41 -- the	12:42:21
3	coefficient 0.41 and the co-efficient 1.47, do not	12:42:25
4	vary substantially?	12:42:31
5	A. Well, when that change is occurring,	12:42:33
6	there's a change in the square term as well on minus	12:42:35
7	.06 to minus .20. So in order to evaluate those --	12:42:38
8	those different functions -- quadratic functions,	12:42:45
9	you have to look at the whole function, not just the	12:42:48
10	intercept, which is what you're focusing on.	12:42:51
11	Q. Did you do that when you used your eyes to	12:42:54
12	look this over?	12:42:58
13	A. Not carefully.	12:42:58
14	Q. Did you run any of those quadratic	12:43:03
15	equations?	12:43:04
16	A. I don't recall.	12:43:07
17	Q. Are you familiar with a Chow test?	12:43:08
18	A. I am.	12:43:12
19	Q. What is a Chow test?	12:43:13
20	A. Chow test is a traditional Fisher's F-test	12:43:17
21	for exploring break points in a series.	12:43:19
22	Q. And what's it designed to test?	12:43:23
23	A. A break point in series. You're looking --	12:43:24
24	you're observing a time series from whatever time	12:43:26
25	interval applies and you estimate a model and want	12:43:29

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1	Q. Compensation on a job-title-by-job-title	12:52:34
2	basis.	12:52:36
3	A. And so the additional stuff that we haven't	12:52:38
4	discussed here is to look at the -- the compensation	12:52:41
5	5 title over time. 'Cause you're quite right, if	12:52:44
6	there were major changes in those title	12:52:50
7	compensation, then these equations are going to	12:52:51
8	disguise -- they're going to look like there isn't	12:52:56
9	change, when there is big change. You got me that?	12:52:59
10	Q. Yes.	12:53:02
11	A. So you've got to worry about the	12:53:03
12	variability in those coefficients, and you've got	12:53:03
13	the sequence of data displays that -- that show you	12:53:07
14	the Figure 15, Figure 16.	12:53:13
15	Q. I'll get to those right after lunch, but --	12:53:20
16	A. Okay.	12:53:22
17	Q. -- let's stay on the regression analysis.	12:53:22
18	A. So you were asking me about title, so these	12:53:25
19	are the -- this is what we did with regard to	12:53:27
20	variability and titles.	12:53:29
21	Q. Okay. But the regression analyses	12:53:31
22	reflected in Figures 11, 12, 13, and 14, don't tell	12:53:32
23	you whether salaries of two employees with two	12:53:39
24	different job titles are correlated with each other	12:53:41
25	over time, correct?	12:53:45

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1	A. That's correct. And that's why we did	12:53:46
2	Figure 15 and 16.	12:53:47
3	MR. PICKETT: Okay. Why don't we take a	12:53:49
4	break on that note?	12:53:50
5	THE VIDEOGRAPHER: We are off the record.	12:53:52
6	The time is 12:54.	12:53:53
7	(Lunch recess taken.)	12:53:54
8	THE VIDEOGRAPHER: This is Disk 5 for	12:53:54
9	Edward Leamer. We're back on the record at 1:36.	13:36:50
10	THE WITNESS: I'm putting them there, so.	13:36:53
11	MR. GLACKIN: Same -- if you can turn to	13:36:55
12	Figure 12.	13:37:00
13	THE WITNESS: Okay.	13:37:02
14	BY MR. PICKETT:	13:37:11
15	So let me go back to the wage suppression	13:37:11
16	regressions for just a moment. I want you to take a	13:37:14
17	look, please, at Figure 12 on page 56, which has the	13:37:19
18	R squares year by year for the seven defendants.	13:37:23
19	And I think you'll agree that these show the levels	13:37:29
20	of compensation at each year, but they don't show	13:37:31
21	the changes of compensation over time, right?	13:37:36
22	A. That's correct.	13:37:38
23	Q. Did you look at what the R squares will be,	13:37:39
24	if you used data showing changes in compensation	13:37:44
25	over the years?	13:37:47

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1   implicated salary structure in one year, implied by   13:45:58

2   one model, and look at the salary structure in the   13:46:01

3   next year to see what that implies, and see the   13:46:03

4   extent to which those things are substantially   13:46:06

5   different --   13:46:09

6   Q.   Uh-huh.   13:46:09

7   A.   -- or is the structure basically very   13:46:09

8   similar on a year-by-year basis.   13:46:11

9   Q.   Let's move on to Figures 15, 16, and 17.   13:46:23

10   These are your constant attribute graphs?   13:46:31

11   A.   Correct.   13:46:36

12   Q.   These are the -- for what purpose did you   13:46:37

13   include these figures?   13:46:41

14   A.   Well, you came very close to the question I   13:46:43

15   thought you were getting at, maybe you said it   13:46:46

16   explicitly, but it's not just that the coefficients   13:46:50

17   change -- don't change much over time, but the   13:46:53

18   average compensation within the -- in the title   13:46:56

19   categories needs to have some kind of smooth   13:46:59

20   movement over time. Because its changes on a   13:47:03

21   year-by-year basis are partly due to changes in the   13:47:05

22   coefficients and partly due to changes in the   13:47:08

23   underlying data.   13:47:12

24   Q.   Why do the average compensation levels need   13:47:13

25   some kind of smooth movement over time?   13:47:16

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1	A. All right. I guess -- perhaps I said that	13:47:25
2	poorly. We -- we were just talking about how the	13:47:27
3	title coefficients need to not change materially on	13:47:30
4	a year-by-year basis, in order for there to be	13:47:34
5	a con- -- constant salary structure. These -- these	13:47:37
6	are versions of those coefficients, illustrations of	13:47:41
7	those coefficients, except for the fact that they	13:47:46
8	control for some of the other characteristics in the	13:47:47
9	equation. Thus they are called constant attributes,	13:47:50
10	meaning holding fixed the -- one of the reasons that	13:47:52
11	these title co-efficients are going to change over	13:47:56
12	time is because the age structure within a title	13:48:00
13	might change. Which on a year-by-year basis	13:48:03
14	everybody gets a year older, you're then adding	13:48:06
15	everybody in that title. So that would naturally	13:48:07
16	induce some change in the average title	13:48:07
17	compensation. These attributes -- constant	13:48:07
18	attribute computation measures control for those	13:48:07
19	features, and ask if you fix the tenure, and you fix	13:48:20
20	the gender, and you fix the age, what does that	13:48:24
21	imply about the base salaries at the top and total	13:48:29
22	compensation at the bottom for some of these titles.	13:48:36
23	Q. Could a difference in the coefficients of	13:48:38
24	10 percent be material in your opinion?	13:48:41
25	A. Well, I would say the materiality is	13:48:44

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1	Q. And you --	13:49:49
2	A. So the compensation across all titles is	13:49:49
3	being raised proportionately.	13:49:50
4	Q. Could a difference in the coefficients of	13:49:53
5	10 percent be material?	13:49:54
6	A. Well, that's a judgment call, but I would	13:50:02
7	say probably not. Depends upon how it applied,	13:50:04
8	whether it was permanent, temporary. I mean, it	13:50:07
9	wouldn't surprise me that on a temporary basis, if	13:50:10
10	you had pressure at one point in the salary	13:50:13
11	structure, you would have a specific title or few	13:50:16
12	titles that would experience larger increases.	13:50:18
13	Q. Would a difference of 20 percent --	13:50:21
14	A. But let me continue. But over time that	13:50:23
15	could be dissipated. And if over time you can have	13:50:26
16	a 20 percent change, which would dissipate over time	13:50:28
17	and drop down to 10 percent, so dropping from 20	13:50:31
18	percent to 10 -- 10 percent, would be symptomatic of	13:50:34
19	the -- of the -- of the sharing. So I'm not going	13:50:37
20	to say any specific number because that doesn't seem	13:50:39
21	to me to address the sharing point.	13:50:43
22	Q. With reference to Figure 15, the Apple job	13:50:50
23	title constant attribute charts.	13:50:53
24	A. Yes.	13:50:57
25	Q. These don't show actual compensation for	13:50:59

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1	any employee, do they?	13:51:02
2	A. No, they do not.	13:51:04
3	Q. They don't even show actual average	13:51:06
4	compensation for any job title, correct?	13:51:08
5	A. They are very close to that. As I told you	13:51:11
6	before, the only difference in what you describe as	13:51:13
7	average is that you remove some of the variability	13:51:16
8	that has to do with changing age structure, changing	13:51:18
9	tenure, and changing gen- -- gender.	13:51:23
10	Q. The results are from your regression,	13:51:24
11	correct?	13:51:26
12	A. But an average, also, results from	13:51:26
13	regression, where you rest your variable on a	13:51:27
14	constant.	13:51:31
15	Q. So by using the results of your regression,	13:51:32
16	you're effectively controlling for individual	13:51:34
17	variation, correct?	13:51:37
18	A. Well, what we are controlling for are	13:51:38
19	changes in the composition of the titles, in terms	13:51:39
20	of these individual variables.	13:51:43
21	Q. Let me make sure I understand. Doesn't --	13:51:49
22	because you use the results from your regressions,	13:51:50
23	you're effectively eliminating individual variation,	13:51:52
24	correct?	13:51:57
25	A. The regression is based on individual	13:52:00

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1	A. I understand that. And --	14:01:35
2	Q. And -- and did you tell Econ 1 to put in	14:01:35
3	the various job titles into these two charts?	14:01:41
4	A. No, they -- they provided me some	14:01:43
5	examples.	14:01:44
6	Q. And you picked among the examples which	14:01:45
7	ones you wanted in?	14:01:46
8	A. I'm not sure. I don't think I picked among	14:01:47
9	them, I think I put in the ones that they gave me.	14:01:49
10	Q. Well, let me -- are you certain that --	14:01:52
11	that they gave you certain data that they selected	14:01:54
12	the job titles, not you?	14:01:58
13	A. Yeah, I'd say, "I'd like to have some of	14:02:03
14	these displays that will speak to" -- "the	14:02:05
15	regression itself is going to carry the day. You've	14:02:07
16	got to show that there isn't major changes in the	14:02:10
17	compensation or end titles that we've been" --	14:02:12
18	"we've been discussing that." And I said, "Please	14:02:14
19	show me some data displays that will support that	14:02:14
20	view" --	14:02:19
21	Q. So --	14:02:20
22	A. -- "or contradict it."	14:02:20
23	Q. Do you know why these ten under base salary	14:02:21
24	were the ten titles selected?	14:02:24
25	A. I -- I would be speculating. Answer is	14:02:27

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```
 1    not --                                           14:02:32

 2       Q.   Do you know why there are only eight job   14:02:32

 3    titles in the total compensation, rather than the  14:02:34

 4    ten shown for base salary?                         14:02:36

 5       A.   No, I don't.                               14:02:37

 6       Q.   Did you -- did somebody plot the other two 14:02:40

 7    and reject them because they didn't fit the        14:02:42

 8    theory?                                            14:02:44

 9            MR. GLACKIN:  I'm going to object to that  14:02:46

10    as argumentative.                                  14:02:46

11    BY MR. PICKETT:                                    14:02:51

12       Q.   Do you know?                               14:02:51

13       A.   I don't know.                              14:02:52
```

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24       Q.   Despite in 2007?                           14:03:16

25       A.   Despite in 2007.                           14:03:18
```

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1   Q.   Right. We'll get to Google in a moment.   14:03:21

2   A.   Okay.   14:03:23

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1	embody. That these shouldn't be thinking of lines,	14:06:51
2	you should be thinking of a swatch of color that are	14:06:55
3	all basically the same throughout the whole	14:06:58
4	period.	14:07:00
5	Q. Now, you testified that some of the other	14:07:01
6	job titles wouldn't look so good. And does that	14:07:03
7	matter to your opinion?	14:07:06
8	A. Sure.	14:07:09
9	Q. In what way is that reflected in your	14:07:10
10	opinion?	14:07:12
11	A. Well, the preponderance of the titles,	14:07:13
12	in my opinion, has the feature that we're looking at	14:07:15
13	here, which is relatively stable.	14:07:20
14	Q. How do you know that? Econ 1 just gave you	14:07:20
15	these?	14:07:25
16	A. Well, I asked them not to do cherry	14:07:25
17	picking, obviously.	14:07:27
18	Q. Yet you have no idea why they gave you ten	14:07:29
19	job titles for base salary and only eight for	14:07:33
20	telecom, right?	14:07:35
21	A. You know, you caught me again. I consider	14:07:36
22	that just to be a typo. It is a typo.	14:07:38
23	Q. Did you look at any job titles and their	14:07:40
24	correlation, other than Apple and Google? Any of	14:07:46
25	the other five defendants?	14:07:50

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```
 1    going to be able to answer these questions very      14:09:02

 2    easily.  We provided you with this information.      14:09:05

 3    It's no mystery.  You know you'd be getting it.  And 14:09:06

 4    we gave you some examples of cases in which there    14:09:10

 5    was substantial evidence of -- of internal job       14:09:12

 6    structures.                                          14:09:15

 7        Q.    Okay.  Let's look at Figure 16, and let's  14:09:16

 8    look at total compensation again.  You think that's  14:09:21

 9    the more important of the two, correct?              14:09:23

10        A.    Well --                                    14:09:25

11        Q.    Total compensation is more important than  14:09:25

12    base salary, in terms of compensation, correct?      14:09:27

13        A.    I think the damage analysis should be done 14:09:31

14    with regard to total compensation.                   14:09:34

15        Q.    Thank you.  And if you look at the total   14:09:36

16    compensation just by eyeballing it, it's your        14:09:38

17    testimony that the lines on Figure 16 for total      14:09:40

18    compensation are roughly parallel?                   14:09:43

19        A.    You're going to be surprised when I say yes 14:09:46

20    because there's really one outstanding observation   14:09:48

21    here.  And for that, one, you got to dig in to see   14:09:50

22    who it is that caused that extreme swing.  And if    14:09:54

23    you eliminate that, then -- then these things are    14:09:58

24    moving parallel, except for the fact that 2007 is -- 14:10:00

25    has this bump up, symptomatic of options and         14:10:03
```

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```
 1    restrictive stock grants given in that year.  2008      14:10:08

 2    is down.  So there's an overall shift up and down,      14:10:11

 3    but these things behave in a -- what I would            14:10:14

 4    consider a very parallel fashion.  With the one         14:10:17

 5    exception, which is the senior staff software           14:10:19

 6    engineer.                                               14:10:23

 7        Q.   So take the light green out -- line out for    14:10:24

 8    that, remaining lines are parallel in your              14:10:27

 9    judgment?                                               14:10:30

10        A.   You can see, if you change the scale so        14:10:32

11    that they are not all squished down at the bottom,      14:10:34

12    you would see parallel -- very substantial parallel     14:10:37

13    movement among those.  Not that they don't cross, I     14:10:40

14    don't mean that, but I mean sufficiently parallel.      14:10:44

15    So by and large, the salary structure is pretty         14:10:46

16    constant over time or over that 3-year int- -- or       14:10:50

17    4-year interval.                                        14:10:51

18        Q.   How do you define "very substantial            14:10:52

19    parallel movement"?                                     14:10:56

20        A.   Well, the ordering is a good way of doing      14:11:00

21    it, for example.  We talked about order before.  I      14:11:01

22    think that you'll see that the ordering is              14:11:04

23    substantially similar at the end, as it is in the       14:11:06

24    beginning.  Substantially similar 2005 as it is in      14:11:09

25    2009.                                                   14:11:13
```

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1	Q. Well, there are changes in the order. I	14:11:13
2	can identify four of them myself right now. Does	14:11:15
3	that matter?	14:11:20
4	A. Well, if it's -- no. If it's a complete	14:11:21
5	mish-mash, things are going up and down, that	14:11:24
6	definitely matters.	14:11:27
7	Q. Does -- (Cross-talking.)	14:11:28
8	A. (Cross-talking.) But I'm not expecting	14:11:28
9	that. But the fact that we're seeing some of these	14:11:29
10	cross -- some of these intersections is completely	14:11:35
11	compatible with the noise that is inherent in this	14:11:37
12	process. So you're seeing the lines, but you don't	14:11:40
13	see error bands around the lines that would allow	14:11:43
14	for a lot more parallelism than you see in that	14:11:47
15	display.	14:11:53
16	Q. Why did you -- why didn't you test whether	14:11:53
17	the relationships are constant over time?	14:11:55
18	A. You're -- you're going to spring on me all	14:11:58
19	these F-tests. I can hear it -- feel it coming.	14:12:01
20	And I'll tell you yet again, it's a silly	14:12:03
21	econometric enterprise, in which it focuses on	14:12:06
22	statistical significance. Statistical significance	14:12:09
23	is measurable. It doesn't mean important. And when	14:12:09
24	you've got 60,000 observations, everything is	14:12:16
25	measurable. So you've got to take that off the	14:12:16

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1	table and throw away issues of measurability and	14:12:17
2	focus on materiality, consequentiality. And	14:12:22
3	that's -- that is not answered by an F-test.	14:12:24
4	Q. So it's less silly to just eyeball the	14:12:27
5	results and determine that they are very	14:12:30
6	substantially parallel?	14:12:34
7	MR. GLACKIN: Objection, argumentative.	14:12:35
8	BY MR. PICKETT:	14:12:36
9	Q. Is that true?	14:12:36
10	A. It's definitely less silly than an F-test,	14:12:38
11	because it focuses on what the question is. The	14:12:41
12	F-test is focusing on the wrong question. I know	14:12:43
13	you're not understanding that, but it's focusing on	14:12:47
14	measurability. Can you measure -- can you -- is	14:12:48
15	there enough data, is the experiment big enough and	14:12:48
16	informative enough so you can tell whether these	14:12:55
17	coefficients are different. And that's not the	14:12:59
18	issue. The issue isn't how big the data set is.	14:13:01
19	The issue is whether the coefficients suggest that	14:13:05
20	there are dramatic changes in the structure of wages	14:13:07
21	over time or, on the other hand, do the coefficients	14:13:10
22	suggest pretty similar structure over time. And	14:13:14
23	that is definitely not what's answered by your	14:13:17
24	F-test.	14:13:19
25	Q. If the -- if you concluded that the data	14:13:20

1	shown for total compensation was, to use your word,	14:13:24
2	a "mish-mash," how would that affect your opinion?	14:13:27
3	A. It would mean that these regressions	14:13:31
4	wouldn't -- wouldn't speak to the point. It doesn't	14:13:33
5	alter the fact that there is wage sharing, because	14:13:36
6	there's ample documentary evidence and there's ample	14:13:40
7	conceptual theory to support the idea that some form	14:13:45
8	of wage sharing is going on, but that it somehow was	14:13:47
9	being disguised and not -- not evident in these	14:13:47
10	particular diagrams. Although, if I found that, you	14:13:47
11	can be sure I'd be thinking of other ways of	14:13:59
12	creating displays that would reveal the wage sharing	14:14:01
13	that was actually going on, even though these might	14:14:04
14	not.	14:14:05
15	Q. How much time did it take you to look at	14:14:06
16	the total compensation chart under Figure 16 and	14:14:08
17	conclude that these lines were very substantially	14:14:15
18	parallel?	14:14:17
19	A. I'm -- I'm attempted to be playful, but	14:14:19
20	I've been told not to. When Picasso was asked how	14:14:21
21	long it took him to draw his most recent painting,	14:14:25
22	he said all his life. Which to some extent is what	14:14:28
23	seems to me to be applicable. Not just take a look	14:14:31
24	at it, it's the whole experience that I've built up	14:14:34
25	in studying data sets and drawing conclusions from	14:14:37

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1	non -- (Cross-talking.)	14:14:40
2	Q. I understand you bring a wealth of	14:14:41
3	experience to the task, but how long did it take you	14:14:42
4	to do the task, look at this and draw the	14:14:46
5	conclusion?	14:14:49
6	A. Well, I -- I took a look at this one, which	14:14:51
7	is Figure 16 at the bottom. I said, "I got to dig	14:14:53
8	into this because you've got that extreme swing,	14:14:56
9	that one wild one." So I dug into the data set and	14:14:59
10	found out who it was, what kind of person was added	14:15:02
11	or subtracted that accounted for this thing.	14:15:07
12	Q. For that one job title?	14:15:08
13	A. That one job title.	14:15:10
14	Q. How long did it take you to conclude that	14:15:12
15	the other nine job titles that are depicted there	14:15:14
16	were substantially parallel?	14:15:15
17	A. That's a -- that's a blink. That's a	14:15:18
18	visual impression.	14:15:20
19	Q. Okay. Do you know if -- do you know how	14:15:39
20	someone selected the ten job titles on the constant	14:15:42
21	attribute chart on Figure 16?	14:15:46
22	A. No, I don't.	14:15:47
23	Q. Do you know -- do you know if the other --	14:15:48
24	do you know how many other job titles there were at	14:15:49
25	Google?	14:15:51

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1	the data?	14:16:56
2	A. Correct.	14:16:56
3	Q. But you're suggesting there are significant	14:16:59
4	numbers of other job titles that may not be	14:16:59
5	consistently smooth --	14:17:03
6	A. Correct.	14:17:07
7	Q. -- over time?	14:17:07
8	A. Correct.	14:17:07
9	Q. Have you looked at why those may not be?	14:17:07
10	A. No, I have not.	14:17:11
11	Q. And does it impact your opinion that there	14:17:12
12	may be lots and lots of job titles of the various	14:17:14
13	defendants that don't move in parallel?	14:17:16
14	MR. GLACKIN: Objection, assumes facts,	14:17:21
15	vague.	14:17:24
16	THE WITNESS: Well, it has not impacted my	14:17:27
17	opinion.	14:17:28
18	BY MR. PICKETT:	14:17:28
19	Q. Has no impact?	14:17:28
20	A. It has not. As I sit here today, it has	14:17:30
21	not because I don't know whether that -- what you're	14:17:32
22	describing is actually accurate.	14:17:36
23	Q. Well, I thought you suggested there were	14:17:38
24	some at Apple who didn't look so good and there was	14:17:42
25	some at Google who wouldn't be parallel. You have	14:17:45

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1	reason to believe that, right?	14:17:47
2	MR. GLACKIN: Objection, mischaracterizes	14:17:50
3	prior testimony.	14:17:50
4	THE WITNESS: Yeah, I think I had	14:17:53
5	conversations with Econ 1 about that issue.	14:17:54
6	BY MR. PICKETT:	14:17:58
7	Q. And what did they tell you?	14:17:58
8	A. Well, I -- I said, "What about this" --	14:18:00
9	"this abnormality in" -- "in Google? Is that	14:18:02
10	characteristic of other ones?" And they said, "Yes,	14:18:06
11	there are other ones that have similar" -- "similar	14:18:10
12	anomalous behavior."	14:18:11
13	Q. Why did you decide not to look into the	14:18:13
14	similar anomalous behavior?	14:18:15
15	A. Well, I guess in the -- in the heat of the	14:18:25
16	moment, I guess that the anomalies would be resolved	14:18:31
17	in the way that they were with regard to this	14:18:35
18	particular observation. And I was relying on Econ 1	14:18:38
19	to confirm that the overall preponderance of the	14:18:44
20	evidence supported the parallelism that they	14:18:46
21	produced in these -- in these diagrams that you see	14:18:48
22	in front of you.	14:18:52
23	Q. What did they do to do that?	14:18:52
24	A. They made these -- I assume they made the	14:18:54
25	displays.	14:18:55

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1	But looked at the data displays. You can do that	14:19:49
2	with one display --	14:19:53
3	Q. But --	14:19:53
4	A. -- at a click of a button. You look so	14:19:53
5	astounded as to that idea. But a click on button,	14:19:56
6	you can make a display of all the lines and you can	14:19:57
7	find the ones that are peculiar very easily.	14:20:00
8	Q. On what basis do you testify under oath	14:20:03
9	that they did that? How do you know it?	14:20:06
10	A. I told you what the basis was.	14:20:08
11	Q. How?	14:20:11
12	A. That we had a conversation about these	14:20:11
13	displays. And I was particularly worried about this	14:20:14
14	Google one that I -- that I ended up doing my own	14:20:18
15	examination of. And I asked for the -- the general	14:20:22
16	impression that they had about the other displays,	14:20:26
17	and whether there were some that were anomalous,	14:20:29
18	like the Google -- that one Google software staff	14:20:32
19	engineer and whether the preponderance was	14:20:35
20	supportive of this idea that there was a salary	14:20:39
21	structure.	14:20:44
22	Q. Who was that conversation with? Name.	14:20:45
23	A. Am I obligated --	14:20:49
24	MR. GLACKIN: Yeah, you can give names, if	14:20:50
25	you can give names.	14:20:52

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1	THE WITNESS: Phil -- Phil Johnson.	14:20:52
2	BY MR. PICKETT:	14:20:56
3	Q. You said Econ 1?	14:20:56
4	A. He's Econ 1.	14:20:58
5	Q. And he -- and how did you connect the	14:20:59
6	general impression to the conclusion that Econ 1	14:21:01
7	looked at each and every one of the job titles over	14:21:03
8	time?	14:21:08
9	MR. GLACKIN: Objection,	14:21:08
10	mischaracterizes.	14:21:09
11	THE WITNESS: No, I said that you can't	14:21:10
12	just pick a few and consider that evidence. You	14:21:12
13	have to know what everything looks like. And I --	14:21:15
14	BY MR. PICKETT:	14:21:17
15	Q. You told that to Mr. Johnson?	14:21:17
16	A. We had a conversation. I don't think it	14:21:19
17	was those exact words, but we had a conversation	14:21:20
18	about these displays. And I was asking for	14:21:23
19	examples. I didn't want to use -- already you're at	14:21:29
20	4,000. I didn't want to put 4,000 in here. So we	14:21:30
21	got a few. And intent was we got a few that would be	14:21:33
22	representative. Representative of a parallelism	14:21:33
23	that you see, but also representative of at least	14:21:42
24	one anomaly, which is the Google total compensation.	14:21:42
25	Q. What do you mean by, "somewhat rigid wage	14:21:47

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1   mind. I don't know if I should help you out on this   14:25:55

2   or not.   14:25:58

3   Q.   What -- fine. I'll bite. What is your   14:25:59

4   definition of a not rigid --   14:26:04

5   A.   I'm saying that I'm not so sure that I   14:26:04

6   should help you out. It seems like this should be   14:26:07

7   your job to articulate the question in a way that I   14:26:09

8   can sensibly answer it.   14:26:09

9   Q.   Answer the question, please.   14:26:10

10   A.   Can I hear the question again?   14:26:12

11   Q.   What is your definition of a nonrigid wage   14:26:13

12   structure?   14:26:16

13   A.   It's -- I told you that a -- a rigid wage   14:26:16

14   structure is one that in response to outside   14:26:20

15   pressure at a certain point in the -- in the   14:26:23

16   compensation design category that that outside   14:26:28

17   pressure that gives rise to higher wages is offset   14:26:32

18   by a sequence of reactions for all the other workers   14:26:36

19   within the firm, in order to keep internal equity in   14:26:40

20   place. So a nonrigid would -- pay structure would   14:26:43

21   be one that was indifferent to internal equity   14:26:46

22   issues.   14:26:52

23   Q.   And so reflect no parallel compensation   14:26:54

24   over time --   14:26:59

25   MR. GLACKIN: Objection.   14:26:59

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 1              MR. PICKETT:  -- among job titles?        14:26:59

 2              MR. GLACKIN:  Objection,                  14:27:01

 3    mischaracterizes.                                   14:27:01

 4              THE WITNESS:  I didn't understand that.   14:27:02

 5    BY MR. PICKETT:                                     14:27:04

 6       Q.   Is there a difference to internal equity --  14:27:04

 7       A.   Yes.                                        14:27:07

 8       Q.   -- that would result in differences in     14:27:07

 9    payment of compensation across job titles?          14:27:09

10              MR. GLACKIN:  Objection, incomplete.      14:27:12

11              THE WITNESS:  You mean in a given year    14:27:17

12    there are differences in --                         14:27:18

13    BY MR. PICKETT:                                     14:27:19

14       Q.   Over time, as you've graphed them on your  14:27:19

15    own charts.                                         14:27:22

16       A.   Yeah, they -- they -- the -- the nonrigid  14:27:24

17    compensation would be evidenced by, say -- let's   14:27:26

18    say, a big bump up in base salary or total          14:27:31

19    compensation for a particular job title that left  14:27:35

20    that particular job title in a new position         14:27:38

21    indefinitely, that didn't get corrected by -- by   14:27:40

22    internal realignments of compensation.              14:27:46

23       Q.   Could a nonrigid wage structure, as you've  14:27:48

24    defined it, lead to parallel lines?                 14:27:50

25       A.   Yes, it could.                              14:27:52
```

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1	category is a bit lower relative to what it was	14:51:13
2	elsewhere -- earlier.	14:51:17
3	Q. And you concluded that was an abnormality?	14:51:18
4	A. It's something that attracts attention.	14:51:22
5	It's not huge, but I'm saying that rather than	14:51:25
6	saying these things are bunched together here and	14:51:28
7	not so bunched together over here on the right, I'm	14:51:29
8	telling you what would -- what attracts my attention	14:51:32
9	is display. Overall the display is supportive of	14:51:34
10	this idea that there's salary structure, but there's	14:51:38
11	some things that -- that suggest something going on	14:51:42
12	that is incompatible with a rigid salary structure.	14:51:45
13	Q. Those two databases?	14:51:49
14	A. Yes.	14:51:53
15	Q. And did you further investigate?	14:51:55
16	A. Those I have not.	14:51:57
17	Q. Now, could two people eyeballing for a --	14:52:01
18	I'll say, say two econometricians eyeballing a	14:52:02
19	graph, such as this, come to a different conclusion	14:52:07
20	as to the smoothness of movement over time?	14:52:10
21	A. Yes, they could.	14:52:12
22	Q. And how would we know who is right?	14:52:14
23	A. Well, your -- the fact is that's true with	14:52:17
24	any data analysis, any economist. You could give two	14:52:20
25	economists the same data set and it would be a	14:52:23

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1	Q. -- when you get them in your paycheck?	15:02:44
2	MR. GLACKIN: Guys, guys, guys, guys, guys,	15:02:47
3	you're talking over each other and it's hard on her.	15:02:47
4	So you finish your answer and then you ask the next	15:02:50
5	question.	15:02:52
6	THE WITNESS: I'm sympathetic to your	15:02:53
7	desire to change the conversations of my economist	15:02:54
8	away from R squared in favor of R, but the reality	15:02:57
9	is that you hear R squared all the time, R squared	15:03:01
10	all the time.	15:03:03
11	BY MR. PICKETT:	15:03:03
12	Q. Uh-huh. So there's a lot of individual	15:03:04
13	variation that is not accounted for at Google in any	15:03:07
14	of the years in the class, correct?	15:03:11
15	A. That's correct.	15:03:13
16	Q. 30, maybe up to 38 percent, right?	15:03:13
17	A. That's correct.	15:03:16
18	Q. And did -- have you studied what the	15:03:16
19	individual variation was, the ranges?	15:03:18
20	A. The percent differences.	15:03:24
21	Q. Yes.	15:03:27
22	A. Like I said, that's in that regression. We	15:03:27
23	could have produced another table that give you --	15:03:30
24	gave you the estimated standard of regression, which	15:03:32
25	would be an estimated amount of uncertainty within	15:03:36

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1	be inconsistent with a conclusion of somewhat rigid	15:51:06
2	price structure?	15:51:10
3	MR. GLACKIN: Objection, vague.	15:51:14
4	THE WITNESS: Say that again, the --	15:51:15
5	BY MR. PICKETT:	15:51:17
6	Q. Would an assumption -- (Cross-talking.)	15:51:17
7	MR. GLACKIN: Just say it a little slower,	15:51:21
8	I mean, seriously.	15:51:23
9	BY MR. PICKETT:	15:51:23
10	Q. I can go as slow as you want. We may not	15:51:23
11	get done, though, today, and we may not get Dr.	15:51:26
12	Leamer on his plane, but I'm happy --	15:51:27
13	MR. GLACKIN: Look, I'm just asking you to	15:51:29
14	slow down the reading of the question, that's all.	15:51:31
15	I had a hard time following it.	15:51:33
16	MR. PICKETT: Okay, I will take as much	15:51:35
17	time as I need.	15:51:36
18	Q. Would an assumption of error terms across	15:51:39
19	individuals in the same period of time be	15:51:41
20	inconsistent with the conclusion that there is a	15:51:44
21	somewhat rigid price structure?	15:51:46
22	A. You know, that's an interesting question,	15:51:56
23	but it's the kind of thing I got to think about. I	15:51:57
24	am not going to give you an answer off the top of my	15:52:00
25	head.	15:52:02

1	Q. Now, in running a regression, do you agree	16:09:16
2	it's important to do a sensitivity analysis?	16:09:19
3	A. Yes, I do.	16:09:21
4	Q. And what is a sensitivity analysis?	16:09:22
5	A. It's a exploration of how sensitive the	16:09:25
6	conclusions are to a choice of variables.	16:09:28
7	Q. And have you done a sensitivity analysis	16:09:29
8	for this regression?	16:09:32
9	A. I've done some alternative equations.	16:09:34
10	Q. Where are those?	16:09:35
11	A. Well, I was asked to report -- let me make	16:09:37
12	clear what the answer is here. What my goal was --	16:09:42
13	my task was to provide a "reliable class-wide or	16:09:48
14	formulaic method capable of quantifying the amount	16:09:52
15	of suppressed compensation suffered by each class."	16:09:55
16	The method is this zero one indicator	16:09:57
17	together with a bunch of other appropriate controls.	16:10:00
18	And that's the standard method by which	16:10:03
19	econometricians produce reliable models. And from	16:10:08
20	among the class of models that I explored, I	16:10:12
21	selected one as the one that would give a	16:10:16
22	sensible estimate, sensible co-efficient, sensible	16:10:19
23	magnitude and produced that here.	16:10:25
24	Q. What alternatives did you consider along	16:10:27
25	the way?	16:10:30

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1	MR. GLACKIN: Okay, at this point, he's	16:10:31
2	described his process, but now you're asking him to	16:10:32
3	describe, my opinion, draft or preliminary work	16:10:35
4	product that is covered by the stipulation.	16:10:36
5	MR. PICKETT: And so you're instructing him	16:10:43
6	not to answer?	16:10:44
7	MR. GLACKIN: I'm instructing him that if	16:10:45
8	the answer to the question would call for him to	16:10:47
9	disclose draft or preliminary work product, then he	16:10:52
10	should not do so. I don't know what his answer to	16:10:54
11	the question is.	16:10:56
12	THE WITNESS: I can't answer that	16:10:57
13	question.	16:10:58
14	BY MR. PICKETT:	16:11:00
15	Q. Did you run a sensitivity analysis on the	16:11:00
16	conduct regression?	16:11:02
17	A. Well, I wouldn't call it a formal	16:11:07
18	sensitivity analysis, but I have studied other	16:11:09
19	models.	16:11:12
20	Q. What did you do to study other models?	16:11:13
21	MR. GLACKIN: I'm going to -- I'm going to	16:11:15
22	give the same instruction. If answering that	16:11:16
23	question would require the disclosure of draft or	16:11:19
24	preliminary work product, then I am instructing him	16:11:22
25	not to disclose that information because that	16:11:24

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 1        Q.    Would you agree, Dr. Leamer, that someone        16:32:36

 2   who is evaluating the conduct regression analysis           16:32:38

 3   would have to reserve judgment on its reliability           16:32:45

 4   until that evaluator saw sensitivity analyses               16:32:51

 5   related to the regression?                                  16:32:58

 6        A.    I would think that the sensitivity analysis      16:33:00

 7   would help to determine reliability.                        16:33:04

 8        Q.    And how sensitive is your regression             16:33:09

 9   analysis?                                                   16:33:13

10        A.    First, you need to know, I did not carry         16:33:13

11   out a complete sensitivity analysis.  I have a              16:33:19

12   record of econometrics that discusses how this              16:33:21

13   should be carried out, and this isn't something I've        16:33:24

14   done.                                                       16:33:26

15             But I have estimated more than one model,         16:33:27

16   more than one that you see in the document, and             16:33:29

17   there is some dimensions in which it's not sensitive        16:33:31

18   and it's sturdy, but there's some dimensions of             16:33:35

19   variability in which the changes can be                     16:33:37

20   substantial.                                                16:33:41

21        Q.    Did you rely on the results of those             16:33:43

22   incomplete sensitivity analyses?                            16:33:47

23        A.    Well, I selected the model which I thought       16:33:49

24   was most appropriate to rely on a model that I              16:33:53

25   regarded reliable.                                          16:33:55
```

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1	Q. So you rejected some models and accepted	16:33:57
2	the one that you chose in your report?	16:34:01
3	A. I selected one to be put into my report,	16:34:05
4	correct.	16:34:08
5	Q. On which dimensions were the alternative	16:34:09
6	models sensitive?	16:34:15
7	MR. GLACKIN: I'm going to instruct him not	16:34:16
8	to answer that question.	16:34:17
9	BY MR. PICKETT:	16:34:19
10	Q. On which dimensions is the current model	16:34:19
11	sensitive?	16:34:27
12	MR. GLACKIN: I'm going to object that	16:34:28
13	that's vague. And if it requires you to disclose	16:34:31
14	draft or preliminary work product, don't answer the	16:34:37
15	question. But if you can answer without doing that,	16:34:39
16	go ahead.	16:34:41
17	THE WITNESS: Can't answer that.	16:34:42
18	BY MR. PICKETT:	16:34:42
19	Q. So you're refusing to let us know why you	16:34:42
20	included some variables and not others in your	16:34:48
21	current regression?	16:34:50
22	A. Well, the logic for the regression I've	16:34:54
23	selected? Are you asking me what that logic is,	16:34:57
24	or --	16:35:00
25	Q. Well, why you did not include the variables	16:35:00

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1	that were in the incomplete alternative sensitivity	16:35:02
2	analysis?	16:35:07
3	A. Well, as I said, there are some dimensions	16:35:08
4	of variability that don't have a material impact on	16:35:09
5	a calculation, and I don't think you're interested	16:35:14
6	to know is because you're going to get the same	16:35:16
7	number under that circumstance.	16:35:18
8	But there are some variability -- some	16:35:20
9	directions of variability in which the conclusions	16:35:21
10	will change substantially. And I made econometric	16:35:23
11	and economic judgments about the coherence of the	16:35:27
12	models that are produced, the accuracy of the	16:35:30
13	estimates that are implied by the model, and	16:35:34
14	selected this one.	16:35:39
15	Q. Sorry?	16:35:40
16	A. Selected this one as my suggested model as	16:35:41
17	they -- that demonstrates the method by which	16:35:44
18	damages can be computed.	16:35:51
19	Q. You're relying on the results of your	16:35:51
20	regression model, correct?	16:35:54
21	A. That's correct.	16:35:55
22	Q. And before you rely on it, you need to know	16:35:58
23	if it's sensitive before relying on it, correct?	16:36:02
24	A. That's correct.	16:36:04
25	Q. And so you determined through the	16:36:04

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1	incomplete sensitivity analysis which variables were	16:36:07
2	sensitive and which were not?	16:36:11
3	A. Yes, correct.	16:36:13
4	Q. And yet you're not willing to tell us the	16:36:14
5	results of that, correct?	16:36:17
6	A. Well, that would be work product --	16:36:18
7	(Cross-talking.)	16:36:19
8	MR. GLACKIN: Actually, hold on. I will	16:36:19
9	withdraw my instruction as to that specific question	16:36:22
10	as to which variables. You can answer that specific	16:36:28
11	question.	16:36:28
12	MR. PICKETT: Well, I'm going to follow-up	16:36:28
13	with why.	16:36:29
14	MR. GLACKIN: Well, I might instruct him --	16:36:31
15	look, I'm trying to -- (Cross-talking.)	16:36:31
16	MR. HINMAN: Let's get why.	16:36:32
17	MR. PICKETT: Okay. Let's start down this	16:36:35
18	slippery slope.	16:36:36
19	MR. GLACKIN: Okay, if you think it's a	16:36:38
20	slippery slope, then we can just not do it. That's	16:36:39
21	fine.	16:36:40
22	MR. PICKETT: I want all answers to all	16:36:40
23	this stuff.	16:36:42
24	MR. GLACKIN: Ask another question --	16:36:43
25	(Cross-talking.)	16:36:43

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 1            MR. PICKETT:  I want answers to all my      16:36:43

 2   questions.  You're the one instructing.             16:36:45

 3            MR. GLACKIN:  I'm understanding you to say  16:36:49

 4   that you think that that answer is not useful to you 16:36:51

 5   unless you can ask follow-up questions that --       16:36:53

 6   (Cross-talking.)                                     16:36:55

 7            MR. PICKETT:  That's not what I said at      16:36:55

 8   all.  That's not what I said at all.                 16:36:56

 9       Q.   Go ahead, answer your question.  Please go  16:36:56

10   ahead.                                               16:36:59

11       A.   You want an example -- (Cross-talking.)     16:36:59

12       Q.   I want all dimensions.                      16:37:01

13       A.   I can't report all because I don't have all 16:37:03

14   of them in front of me.                              16:37:05

15       Q.   All that you recall.                        16:37:06

16       A.   Well, I recall one which has to do with     16:37:07

17   disaggregation with data by a defendant.  So I have  16:37:14

18   a model that has all the defendants --               16:37:17

19            MR. GLACKIN:  Wail, wait, wait, wait, I'm    16:37:19

20   going to instruct you not to answer further.         16:37:22

21            THE WITNESS:  Okay.                          16:37:25

22   BY MR. PICKETT:                                      16:37:31

23       Q.   What were the results of the                16:37:31

24   disaggregation?                                      16:37:32

25            MR. GLACKIN:  If you answer something other  16:37:36
```

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1	than "I don't know," or "I don't remember," I'm	16:37:37
2	going to instruct you not to answer.	16:37:40
3	THE WITNESS: I don't remember the	16:37:40
4	details.	16:37:40
5	BY MR. PICKETT:	16:37:41
6	Q. Did you retain that work?	16:37:41
7	A. Well, I don't know what you mean by	16:37:42
8	retention, but a model like that probably sits on --	16:37:45
9	in my hard dive somewhere I suppose.	16:37:48
10	Q. Does Econ One have any data associated with	16:37:51
11	that analysis -- the disaggregation analysis?	16:37:54
12	A. Well, it's not hard to do. Your experts	16:38:00
13	will be able to do it with a press of a button. So	16:38:02
14	that's not something that has to be produced in	16:38:07
15	order to do it.	16:38:08
16	Q. Could you answer the question, please?	16:38:09
17	A. I don't know what's on Econ One	16:38:10
18	computers.	16:38:13
19	Q. But you have something on your hard drive	16:38:13
20	that you haven't produced to us related to the	16:38:15
21	disaggregation?	16:38:17
22	A. I don't know that that's the case. I could	16:38:19
23	tell you it was on the hard drive once. But whether	16:38:21
24	I retained it or not, I can't tell.	16:38:23
25	Q. So you could have deleted it, you could	16:38:25

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1	particular variable, correct?	16:40:20
2	MR. GLACKIN: Objection, vague.	16:40:22
3	THE WITNESS: I think it would be better to	16:40:23
4	describe it as an estimation process that allows, in	16:40:25
5	principle, originating across firms versus the other	16:40:29
6	model that I report in this paper -- in this report	16:40:35
7	that in which the heading they used is eliminated	16:40:39
8	except for the intersect terms. I made a judgment	16:40:42
9	that the efficiency gains that comes from pooling	16:40:46
10	across firms and posing the restriction that there	16:40:50
11	is a similarity in the -- in the -- similarity of	16:40:55
12	the impact of these various variables across firms.	16:41:02
13	This is not a very coherent sentence.	16:41:05
14	Any way, so if you pool across firms, you	16:41:07
15	get an efficiency gain because you're estimating	16:41:13
16	fewer parameters instead of -- suppose there are 20	16:41:16
17	variable in this equation, instead of just 20, if	16:41:19
18	you disaggregate, you have to estimate six times 20	16:41:22
19	parameters. That's an efficiency loss.	16:41:25
20	It's better to pool to the extent that the	16:41:28
21	firms are sufficiently similar, and to the extent	16:41:31
22	that the efficiency gain more than offsets the loss	16:41:34
23	inaccuracy that comes from originating among firms.	16:41:37
24	And so I made the judgment that it was	16:41:41
25	better to pool across firms in order to create a	16:41:42

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1	more coherent, more efficient model.	16:41:46
2	BY MR. PICKETT:	16:41:50
3	Q. Wouldn't the disaggregation, though, lead	16:41:50
4	to more accurate results on an individual	16:41:53
5	defendant-by-defendant basis?	16:41:55
6	A. No, I told you why not, because you --	16:41:56
7	because there is a loss of efficiency.	16:41:58
8	Q. How do you know if the defendants are	16:42:03
9	sufficiently similar in order for you to pool the	16:42:09
10	results?	16:42:13
11	A. Well, that can be done with a formal test.	16:42:13
12	You can do the -- instead of a zero one outcome, you	16:42:16
13	can use weighted averages based on the F statistic.	16:42:22
14	Q. What did you do?	16:42:26
15	A. I did not carry out that estimate, but	16:42:26
16	examined the models by defendant by defendant.	16:42:30
17	Q. This is eyeballing Figures 15, 16 and 17?	16:42:36
18	MR. GLACKIN: Were you finished with your	16:42:40
19	answer?	16:42:41
20	THE WITNESS: No, I was not.	16:42:41
21	MR. GLACKIN: Go ahead and finish your	16:42:43
22	answer.	16:42:45
23	THE WITNESS: In this case, I was	16:42:45
24	eyeballing regression outputs and determining	16:42:47
25	whether the coefficients were sufficiently -- had	16:42:49

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1	large errors and extreme outcomes, and therefore,	16:42:55
2	were less reliable.	16:42:58
3	BY MR. PICKETT:	16:43:01
4	Q. Is that Figure 20?	16:43:01
5	A. No, it's not Figure 20.	16:43:02
6	Q. What is it then?	16:43:03
7	A. Like I said, I've carried out an extensive	16:43:05
8	sensitive analysis in several different directions,	16:43:08
9	not a complete one, but it's substantial. And I'm	16:43:10
10	imploring you, at your request, the direction in	16:43:13
11	which the risk of substantial sensitivity.	16:43:17
12	Q. But you're not willing to share that work	16:43:19
13	with us?	16:43:21
14	MR. GLACKIN: No, I'm not willing to share	16:43:22
15	it with you. I mean, we have an agreement not to	16:43:24
16	share that work. It's not about his willingness.	16:43:26
17	Let's make that clear.	16:43:29
18	THE WITNESS: But trust me, you've got it.	16:43:31
19	You've got the data, and you can estimate these	16:43:32
20	equations. You've got the people who can carry this	16:43:35
21	out with a press of a button. It's no mystery.	16:43:39
22	Nobody is hiding anything.	16:43:39
23	BY MR. PICKETT:	16:43:40
24	Q. Why did you engage in these incomplete	16:43:40
25	sensitivity analysis?	16:43:43

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1    that we looked at.  But I can't recall which --        16:46:13

2    exactly what the sensitivity analysis was.  I can't    16:46:16

3    recall exactly, the models were estimates.             16:46:19

4        Q.    What do you recall generally?               16:46:22

5        A.    I told you what it was generally.  That     16:46:23

6    there was some dimensions in which the model wasn't    16:46:24

7    very sensitive, and some that were not.  And I         16:46:28

8    disclosed the -- the most -- the largest sensitivity   16:46:31

9    issues, which is the disaggregation by firms.          16:46:34

10       Q.    And I'm asking you what other ones, maybe    16:46:39

11   they weren't as important as disaggregation, but       16:46:42

12   what other ones were there that you analyzed and       16:46:44

13   rejected based on these various sensitivity            16:46:48

14   analyses?                                              16:46:49

15       A.    And I'm telling you, I don't recall.         16:46:52

16       Q.    You said you did not recall specifically,    16:46:54

17   you also don't have a general recollection?            16:46:58

18           MR. GLACKIN:  No, he said he does not          16:46:58

19   recall.  You're putting words in his mouth.            16:46:59

20           MR. PICKETT:  He earlier said --               16:47:03

21           MR. GLACKIN:  Well, just now you asked him,    16:47:04

22   he's said, "I don't recall."                           16:47:05

23           MR. PICKETT:  Let's not fence.                 16:47:08

24       Q.    Do you have any recollection whatsoever of   16:47:09

25   the work you did on sensitivity analyses other than    16:47:10
```

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```
 1    to encourage them to use graphical displays rather       16:50:58

 2    than numerical calculations because they understand      16:51:01

 3    the graphs in the way they don't understand the          16:51:05

 4    numbers.                                                  16:51:07

 5    BY MR. PICKETT:                                           16:51:08

 6        Q.    Have you heard the term "counting your         16:51:08

 7    wealth in small change"?                                  16:51:09

 8        A.    Yes, I have.                                    16:51:13

 9        Q.    And what does that mean?                        16:51:13

10        A.    That comes from a teacher of mine, Dan         16:51:14

11    Suits (phonetic), who talked about if you -- instead     16:51:17

12    of using annual data, you used quarterly data or if      16:51:21

13    you starting using quarterly data, you used monthly      16:51:23

14    data, you were not getting, in effect, more              16:51:26

15    experience, you were just disaggregating                 16:51:29

16    experiments, and that's the sense of which counting      16:51:31

17    the wealth in small change.  It's an illusion of         16:51:36

18    greater observations, not the reality of it.             16:51:38

19        Q.    How would you test whether someone was         16:51:42

20    doing that?                                               16:51:44

21        A.    Well, that setting is quite                    16:51:44

22    straightforward.  You use a dynamic model that           16:51:49

23    allows for the interdependence.  So if you use           16:51:49

24    monthly data, you're going to use a longer dynamic       16:51:52

25    model to deal with the interdependence.  Because if      16:51:53
```

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1	it's annual data you use a shorter.	16:51:58
2	Q. Do you know whether any of the data you	16:52:00
3	used in your regressions would fall under the rule	16:52:02
4	of counting your wealth in small change?	16:52:05
5	A. Well, I've got -- if you're talking about	16:52:09
6	an aggregation -- you're talking about time issues,	16:52:11
7	I've got this two-year -- two lag variables, beyond	16:52:13
8	annual observations, so my damage model allows a	16:52:18
9	compensation in one year to depend -- at an	16:52:23
10	individual level, to depend on a compensation they	16:52:26
11	had last year and the previous year.	16:52:29
12	with regard to that equation.	16:52:30
13	Q. Let's move aside from that particular time	16:12:37
14	element. You treated correlated data with error	16:52:39
15	terms as if they were independent, correct?	16:52:42
16	A. So we're going to come back to this	16:52:42
17	clustering point --	16:52:43
18	Q. Yes.	16:52:43
19	A. -- hoping to hear more about. And if	16:52:43
20	you're talking about counting your wealth in small	16:52:43
21	change in a sense of having lots of individuals but	16:52:52
22	only having one experiment at a firm, I recognize	16:52:54
23	that -- that seems like appropriate use of that	16:52:57
24	language. I've gone in that direction to some	16:53:01
25	extent because I have firm indicators, but I'm	16:53:05

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```
 1    anxious to see what your experts are doing with        16:53:07

 2    regard to this issue.                                  16:53:10

 3           And as I sit here today, there's all kinds      16:53:11

 4    of ways you might be addressing that issue, and I'm    16:53:15

 5    sure I'm going to learn something from it.             16:53:18

 6       Q.   Let's look at Figure 19.  It's on page 63.     16:53:20

 7       A.   Yes.                                           16:53:24

 8       Q.   This shows an average change in total          16:53:25

 9    compensation for all seven defendants, correct?        16:53:31

10       A.   That's correct.                                16:53:45

11       Q.   Why did you include Figure 17 in your          16:53:46

12    analysis?                                              16:53:48

13       A.   Figure 19, you mean?                           16:53:49

14       Q.   Figure 19.                                     16:53:51

15       A.   This is meant to be a warmup in -- to the      16:53:54

16    regression analysis.  So you have kind of laying out   16:53:57

17    how this approach is going to work.                    16:53:59

18       Q.   Is it relevant to your opinion?                16:54:03

19       A.   It's relevant to your understanding of my      16:54:05

20    opinion.  So my opinion does not pend on this          16:54:09

21    display.  Although, to some extent, it gives an        16:54:10

22    order of magnitude.  It gives a sense of how big the   16:54:16

23    numbers might be.                                      16:54:18

24           But the main point of the display is to         16:54:20

25    illustrate the -- the -- the before and after kind     16:54:22
```

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1	of calculation that's implied by the conduct	16:54:25
2	variables.	16:54:27
3	Q. Did you include one-time compensation	16:54:28
4	events in your average?	16:54:29
5	A. One time compensation events?	16:54:30
6	Q. Sign-up incentives you talk about in your	16:54:32
7	report, for example?	16:54:34
8	A. I often have had the new employees	16:54:35
9	excluded.	16:54:40
10	Q. Did you?	16:54:42
11	A. And in this data set, I'm not entirely	16:54:43
12	sure.	16:54:48
13	Q. Does it indicate you have excluded	16:54:49
14	employees, you have a number of employees on the	16:54:50
15	left-hand side?	16:54:51
16	A. Well, I'd said -- you see note No. 1, it	16:54:56
17	says, "Changes in compensation measured only on	16:54:57
18	employees that did not switch jobs from previous	16:54:59
19	year."	16:55:01
20	Q. You have an opinion that the years 2004 and	16:55:03
21	2011 are significant useful comparisons?	16:55:06
22	A. Well, this is hypothetical. So if you look	16:55:14
23	at this data set, you might think that 2011 was a	16:55:16
24	period of time of rapid expansion in the tech	16:55:25
25	sector, and 2004 was the aftermath of the tech	16:55:26

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1	anxious to see what your experts are doing with	16:53:07
2	regard to this issue.	16:53:10
3	And as I sit here today, there's all kinds	16:53:11
4	of ways you might be addressing that issue, and I'm	16:53:15
5	sure I'm going to learn something from it.	16:53:18
6	Q. Let's look at Figure 19. It's on page 63.	16:53:20
7	A. Yes.	16:53:24
8	Q. This shows an average change in total	16:53:25
9	compensation for all seven defendants, correct?	16:53:31
10	A. That's correct.	16:53:45
11	Q. Why did you include Figure 17 in your	16:53:46
12	analysis?	16:53:48
13	A. Figure 19, you mean?	16:53:49
14	Q. Figure 19.	16:53:51
15	A. This is meant to be a warmup in -- to the	16:53:54
16	regression analysis. So you have kind of laying out	16:53:57
17	how this approach is going to work.	16:53:59
18	Q. Is it relevant to your opinion?	16:54:03
19	A. It's relevant to your understanding of my	16:54:05
20	opinion. So my opinion does not pend on this	16:54:09
21	display. Although, to some extent, it gives an	16:54:10
22	order of magnitude. It gives a sense of how big the	16:54:16
23	numbers might be.	16:54:18
24	But the main point of the display is to	16:54:20
25	illustrate the -- the -- the before and after kind	16:54:22

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1	of calculation that's implied by the conduct	16:54:25
2	variables.	16:54:27
3	Q. Did you include one-time compensation	16:54:28
4	events in your average?	16:54:29
5	A. One time compensation events?	16:54:30
6	Q. Sign-up incentives you talk about in your	16:54:32
7	report, for example?	16:54:34
8	A. I often have had the new employees	16:54:35
9	excluded.	16:54:40
10	Q. Did you?	16:54:42
11	A. And in this data set, I'm not entirely	16:54:43
12	sure.	16:54:48
13	Q. Does it indicate you have excluded	16:54:49
14	employees, you have a number of employees on the	16:54:50
15	left-hand side?	16:54:51
16	A. Well, I'd said -- you see note No. 1, it	16:54:56
17	says, "Changes in compensation measured only on	16:54:57
18	employees that did not switch jobs from previous	16:54:59
19	year."	16:55:01
20	Q. You have an opinion that the years 2004 and	16:55:03
21	2011 are significant useful comparisons?	16:55:06
22	A. Well, this is hypothetical. So if you look	16:55:14
23	at this data set, you might think that 2011 was a	16:55:16
24	period of time of rapid expansion in the tech	16:55:25
25	sector, and 2004 was the aftermath of the tech	16:55:26

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1	downturn. And suppose then, you use them as	16:55:29
2	comparison years of before relevant -- before and	16:55:33
3	after years, that gives you an average increase in	16:55:35
4	compensation that's around 10 percent.	16:55:40
5	Q. Why not use 2010 as your after period?	16:55:43
6	A. Well, that's perfectly good, we can go with	16:55:47
7	that direction, but we have to talk about whether	16:55:50
8	which is the relevant comparison. And the thing is	16:55:52
9	that 2008 and '-9 were definitely recession periods.	16:55:57
10	2010 was the beginning of the aftermath, maybe 2011	16:56:01
11	was a more normal period. I'm not saying -- I'm not	16:56:07
12	saying yes. I'm not endorsing what I did, the	16:56:09
13	specifics of what I did.	16:56:12
14	The point is I'm trying to communicate how	16:56:15
15	the before and after calculation is done, where you	16:56:17
16	find a relevant before period, a relevant after	16:56:20
17	period, and you compute what would have happened had	16:56:22
18	the interim -- the period in which the agreement was	16:56:25
19	in place, what would have happened if it was more	16:56:28
20	like the before and after.	16:56:31
21	The regression has a much more	16:56:33
22	sophisticated way of identifying before and after.	16:56:35
23	Q. Your -- (Cross-talking.)	16:56:38
24	A. Please don't think that -- that this is the	16:56:38
25	work that I'm relying on trying to just introduce	16:56:38

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1	Q. The individual's --	17:30:52
2	A. -- depends on the number of new hires. But	17:30:53
3	it's a very -- it's a model that describes an	17:30:56
4	individual, not the firm. So you'd have to carry	17:30:59
5	out this exercise -- if you're interested in Adobe,	17:31:02
6	you'd have to carry out the exercise with regard to	17:31:03
7	all employees at Adobe, allowing for the different	17:31:05
8	ages, and tenure, and etc.	17:31:08
9	Q. To -- to find individual impact?	17:31:11
10	A. I -- I think that that's a	17:31:14
11	misinterpretation. It's rather -- you aggregate	17:31:15
12	that then to the level of the firm by summing up	17:31:18
13	over all Adobe employees, and that estimate is an	17:31:22
14	estimate that is corrected for the age competition	17:31:25
15	of an employee of the Adobe workforce.	17:31:28
16	Q. And the only two variables within a company	17:31:30
17	that make a difference are age and number of new	17:31:33
18	hires?	17:31:38
19	A. Correct. Those are the only two that drive	17:31:38
20	the conduct variable.	17:31:45
21	Q. Now, this is an aggregated regression,	17:31:48
22	correct? Not disaggregated by company?	17:31:50
23	A. Well, this is individual data.	17:31:55
24	Q. The analysis is not disaggregated, it's	17:31:57
25	aggregated, correct?	17:31:58

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1   MR. GLACKIN: Objection, vague,   17:32:01

2   mischaracterizes.   17:32:02

3   THE WITNESS: Well, the data from all firms   17:32:03

4   are included in the estimation process.   17:32:06

5   BY MR. PICKETT: 17:32:08

6   Q.   All right. Let me go back. You did run a   17:32:08

7   disaggregation analysis, correct?   17:32:09

8   A.   Yeah, that's what I just said. I mean,   17:32:13

9   maybe I ought to repeat what I said, which is this   17:32:15

10   regression is not disaggregated, in the sense that   17:32:17

11   includes observation from all firms.   17:32:22

12   Q.   Correct.   17:32:26

13   A.   Although, it does have variables that   17:32:26

14   describe differences among the firms.   17:32:29

15   Q.   It describes data from all firms,   17:32:31

16   correct?   17:32:34

17   A.   It uses the input data from all firms.   17:32:34

18   Q.   So it is not disaggregated firm by firm by   17:32:37

19   firm?   17:32:39

20   A.   If you use the word "disaggregation" to   17:32:40

21   refer to estimating the same equation on subsets of   17:32:45

22   the data on a firm-by-firm basis, that's not what   17:32:47

23   this is.   17:32:49

24   Q.   And the result you get is aggregated,   17:32:52

25   true?   17:32:57

1	MR. GLACKIN: Objection, vague.	17:33:03
2	THE WITNESS: No, it's not true.	17:33:04
3	BY MR. PICKETT:	17:33:05
4	Q. You used one conduct variable, right?	17:33:05
5	A. That's correct. One -- well, it's a	17:33:07
6	conduct variable that varies across firms. It's not	17:33:09
7	just on, off, all the same for all firms because	17:33:12
8	these firms have different periods in which they had	17:33:16
9	the conduct turned on. So there's some firm -- firm	17:33:21
10	variability that comes from pure conduct.	17:33:23
	███ ██ █████████████████ ███	
	██ ███████████████████████ ███	
	██ ████████████████████████ ███	
14	A. Well, approximately. And that's what this	17:33:46
15	model suggests, yes.	17:33:48
	██ ██ ██████████████████ ███	
17	A. Correct.	17:33:52
18	Q. Is that consistent with your information	17:33:52
19	flow theory?	17:33:54
20	A. Well, I think the theory is ambiguous with	17:33:57
21	regard to magnitudes. And I use the regression	17:34:02
22	analysis to compute in magnitudes.	17:34:05
23	Q. Why would anyone come to Lucas in 2008 or	17:34:09
24	2009, if they were being paid 20 percent under the	17:34:13
25	market?	17:34:16

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1	MR. GLACKIN: Objection, mischaracterizes.	17:34:17
2	THE WITNESS: Well, I'm tired here. The	17:34:56
3	answer is that's what the model says, but then	17:35:00
4	you're raising another question, which is, is the	17:35:03
5	model compatible with the -- the set of	17:35:05
6	opportunities.	17:35:08
7	MR. PICKETT: Right.	17:35:10
8	THE WITNESS: And in my tired state, I	17:35:11
9	can't produce a story that would justify that.	17:35:17
10	BY MR. PICKETT:	17:35:21
11	Q. Why does compensation depend on the number	17:35:21
12	of new hires at all defendants? Why wouldn't it	17:35:23
13	depend on the number of new hires total, including	17:35:27
14	the nondefendants?	17:35:30
15	A. Where -- are you talking about row 3?	17:35:34
16	Q. Correct.	17:35:35
17	A. Well, row 3 is telling you that -- it's	17:35:36
18	identifying the firms that are going to be most	17:35:39
19	affected by the cold calling and the anti-cold	17:35:42
20	calling agreements. It's those firms that would	17:35:47
21	have been -- that were hiring substantially who	17:35:50
22	probably would have been doing a cold calling. So	17:35:52
23	you raise another possibility, that it could be --	17:35:55
24	another variable you might explore is the number of	17:35:58
25	new hires in total --	17:36:01

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```
 1        Q.    I'm asking about your use of the            17:42:00

 2   vocabulary, sir.                                       17:42:01

 3        A.    Yes.                                        17:42:01

 4        Q.    You understand that poaching is allowed     17:42:01

 5   under the bilateral agreement?                         17:42:05

 6        A.    Correct.                                    17:42:07

 7        Q.    Let's move on then.  If you go to paragraph 17:42:14

 8   72, please, of your report.                            17:42:19

 9        A.    All right.                                  17:42:29

10        Q.    Page 31.  You state that "The speed at      17:42:29

11   which the price discovery process operates is          17:42:30

12   determined by the frequency at which buyers and        17:42:33

13   sellers get together to haggle over the price.  And    17:42:37

14   also by a rate at which information is dispersed."      17:42:40

15   Do you know whether there was a change in the          17:42:45

16   frequency at which buyers and sellers got together     17:42:50

17   to haggle over the price during the class period?      17:42:54

18        A.    Well, of course, I regard the cold calling  17:42:59

19   as an introduction, the beginning part of the --       17:43:01

20   well, what might be called haggling.  But we don't     17:43:04

21   have any data on cold calling or haggling.             17:43:07

22        Q.    And you -- so you don't have any data that  17:43:12

23   shows you the frequency at which buyers and sellers    17:43:18

24   got together to haggle over the price during the       17:43:20

25   class period, correct?                                 17:43:24
```

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```
 1              MR. GLACKIN:  Objection, asked and          17:43:25

 2    answered.  And we've covered this ground many times.   17:43:25

 3              THE WITNESS:  That's correct.                17:43:25

 4    BY MR. PICKETT:                                        17:43:27

 5        Q.   And if there were no material change in the   17:43:27

 6    frequency of the bargaining, then you would not        17:43:29

 7    expect there to be affect -- an effect on price        17:43:32

 8    discovery, correct?                                    17:43:33

 9        A.   Well, the frequency is one thing, but the     17:43:35

10    character of the bargaining also mattered.  But I      17:43:35

11    would say what this says is probably, generally,       17:43:40

12    true.                                                  17:43:42

13        Q.   Paragraph 74 on that same page states that,   17:43:45

14    "High-tech jobs involve" -- "involve high costs for    17:43:49

15    transactions, including time, money, and personal      17:43:51

16    dislocation."  What do you mean by "high-tech          17:43:55

17    jobs"?                                                 17:44:01

18        A.   These jobs that we're discussing at these     17:44:01

19    high-tech firms.                                       17:44:05

20        Q.   So every job at one of these seven            17:44:06

21    companies is a high-tech job, whether you're a         17:44:08

22    cafeteria worker or a secretary?                       17:44:12

23              MR. GLACKIN:  Objection, mischaracterizes,   17:44:16

24    argumentative.                                         17:44:19

25              THE WITNESS:  No, I would not use the word   17:44:19
```

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1	transactions."	17:50:26
2	Is your opinion that the challenged	17:50:27
3	agreements reduced the number of bilateral bargains	17:50:29
4	during the class period?	17:50:32
5	A. Well, I include bargains, conduct in	17:50:35
6	general. And my opinion is that the anti-cold	17:50:38
7	calling agreements did reduce the number of	17:50:43
8	contacts.	17:50:45
9	Q. So a bargain is not an agreement, it's a --	17:50:46
10	it's a discussion about potential agreements?	17:50:49
11	MR. GLACKIN: Objection, argumentative,	17:50:54
12	mischaracterizes.	17:50:55
13	THE WITNESS: It's a communication -- I	17:50:57
14	want it to be defined as a communication that	17:50:57
15	reveals information about possibilities.	17:51:00
16	BY MR. PICKETT:	17:51:04
17	Q. And --	17:51:04
18	A. And the more that that goes on, the more	17:51:08
19	rapidly will be the finding of the equilibrium	17:51:09
20	market.	17:51:12
21	Q. How do you know that other cold calls to	17:51:12
22	other employers and employees didn't substitute?	17:51:16
23	A. This one we've been on before, too. So the	17:51:23
24	answer is, I -- I don't have evidence on that.	17:51:26
25	Q. So you don't know whether the price	17:51:30

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1	A. They would, yes.	18:08:29
2	Q. And that information flow would generate	18:08:30
3	from these movers, join the other firms, correct?	18:08:32
4	A. There would be information as a consequence	18:08:38
5	of these movers, and as a consequence of the whole	18:08:40
6	bargaining that led up to the move.	18:08:43
7	Q. Right. So did you investigate whether	18:08:45
8	there was enough movement to impact the information	18:08:46
9	flow?	18:08:51
10	MR. GLACKIN: Objection, asked and	18:08:52
11	answered.	18:08:53
12	THE WITNESS: So, again, we're going to	18:08:54
13	rely on the -- on the regression model. These are	18:08:54
14	conceptual possibilities that we're going to have to	18:08:58
15	ultimately fall back on regression models to	18:08:59
16	determine the impact.	18:09:01
17	BY MR. PICKETT:	18:09:06
18	Q. Let me ask you to turn to paragraph 95 on	18:09:06
19	page 39. There you state that, "Cold calling is	18:09:16
20	likely to be most active during the industry	18:09:22
21	expansions in which the industry overall is enjoying	18:09:25
22	rapid growth and facing supply constraints of	18:09:29
23	workers at every level experience."	18:09:29
24	Do you have any support for that, factually	18:09:34
25	or theoretical?	18:09:37

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1	A. Almost all.	18:14:42
2	Q. Almost all were expanding between 2005	18:14:43
3	and 2009?	18:14:46
	▮ ▮ ▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮ ▮▮▮	
	▮ ▮▮▮▮▮▮▮ ▮▮▮	
6	Q. Did you look at the other five?	18:14:50
7	A. I looked at the other five.	18:14:51
8	Q. And they weren't expanding, were they?	18:14:53
9	A. Well, if I recall correctly, Intel was	18:14:55
10	declining a little bit and the other ones were more	18:14:58
11	mixed in their behavior.	18:15:00
12	Q. So what does a period of expansion for two	18:15:03
13	of the defendants tell you?	18:15:05
14	A. Well, the -- the total workforce among	18:15:08
15	these firms was increasing. I mean, it's -- take a	18:15:11
16	look at that.	18:15:16
17	Q. Total in the labor market or total	18:15:19
18	overall?	18:15:21
19	MR. GLACKIN: Objection, mischaracterizes	18:15:22
20	his testimony.	18:15:23
21	THE WITNESS: Yeah, I don't have it here in	18:15:32
22	front of me, but I'm quite sure that if you summed	18:15:33
23	up the employment across all these firms, you would	18:15:36
24	see that it was rising in 2005, -6, and -7.	18:15:39
25	BY MR. PICKETT:	18:15:43

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```
 1        Q.   Are Google and Facebook product market        18:36:42

 2    competitors?                                            18:36:44

 3        A.   They -- they may be in some ways competing     18:36:51

 4    for the same kind of customers.                         18:36:55

 5        Q.   Are any of the other defendants product        18:36:57

 6    market competitors during the class period?             18:36:58

 7        A.   So you're asking me whether the products       18:37:06

 8    that they have for sale are substitutes on -- for       18:37:09

 9    consumers?                                              18:37:15

10        Q.   Correct.                                       18:37:15

11        A.   I don't think I know the whole list of         18:37:18

12    Adobe products -- Adobe software products and the       18:37:20

13    extent to which that competes with products provided    18:37:24

14    by one of the other defendants, so I'm not in a         18:37:27

15    position to answer that question.                       18:37:30

16        Q.   Does the fact that -- let me ask you this.     18:37:34

17    Let me ask you to look at paragraph 107, where you      18:37:39

18    say that "Google recognized that it becomes the         18:37:46

19    target of substantial recruiting from Facebook."        18:37:49

20    That's the fourth line.  Do you see that?               18:37:57

21        A.   I see that.                                    18:38:03

22        Q.   What do you mean by "substantial               18:38:06

23    recruiting"?                                            18:38:08

24        A.   That -- that they were losing employees --     18:38:09

25    substantial number of employees to Facebook.            18:38:11
```

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```
 1        A.   Correct.                                18:43:47

 2        Q.   Some may get zero percent, some may get  18:43:48

 3   double --                                          18:43:50

 4        A.   Correct.                                18:43:50

 5        Q.   -- the target, correct?                 18:43:50

 6        A.   Yeah.                                    18:43:51

 7        Q.   So this is unique.  This went 10 percent to  18:43:52

 8   everybody, correct?                                18:43:55

 9             MR. GLACKIN:   Objection --              18:43:57

10             MR. PICKETT:   The Google --             18:43:58

11             MR. GLACKIN:   -- compound.              18:43:58

12             THE WITNESS:   I mean, yeah, in the absence  18:43:59

13   of 10 percent.  This is unusual and unique.        18:43:59

14   BY MR. PICKETT:                                    18:44:03

15        Q.   So only across -- the only strictly      18:44:03

16   across-the-board raise was this one by Google in   18:44:04

17   response to Facebook?                              18:44:08

18        A.   That's correct.                          18:44:09

19        Q.   And no defendant, other than this one    18:44:11

20   example, has done a strictly across-the-board      18:44:14

21   increase in compensation at any time?              18:44:17

22        A.   Not to my knowledge.                     18:44:19

23        Q.   Now, let me ask you to look at a Google  18:44:22

24   exhibit that you cite.  It's -- we'll call it      18:44:30

25   Exhibit 88.  It's G-O-O-G, High-Tech 00193217.  It's  18:44:35
```

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1	MR. GLACKIN: I'll give you 7:03.	18:54:33
2	BY MR. PICKETT:	18:54:33
3	Q. Let me refer you to paragraph 122, please.	18:54:34
4	You state, "Typically high-level management	18:54:42
5	establishes ranges of salaries for grades and	18:54:45
6	titles, which left relatively little scope for	18:54:48
7	individual variation."	18:54:51
8	By "typically," do you mean sometimes with	18:54:55
9	respect to the defendants, but not always?	18:54:57
10	A. Well, I think they all have annual salary	18:55:00
11	reviews. I might be wrong about all, but my	18:55:05
12	impression is they all do.	18:55:07
13	Q. Do they all establish ranges for salaries	18:55:07
14	by grades and titles, which left relatively little	18:55:11
15	scope for individual variations?	18:55:12
16	A. I can't say for sure all, but I would say	18:55:16
17	most do establish target ranges. We talked about	18:55:18
18	that before, target ranges for grades and to some	18:55:20
19	extent titles.	18:55:23
20	Q. What do you mean by "relatively little	18:55:24
21	scope"?	18:55:26
22	A. That the -- within the title, maybe within	18:55:28
23	the grade, there's going to be scope for the manager	18:55:30
24	to vary the amount of compensation up or down a	18:55:33
25	little bit, but the overall salary scale that	18:55:37

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1   MR. GLACKIN: Objection, mischaracterizes.   18:57:24

2   THE WITNESS: Well, for which grades did   18:57:27

3   you say?   18:57:28

4   BY MR. PICKETT: 18:57:28

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1	MR. GLACKIN: Objection, foundation.	18:58:52
2	THE WITNESS: Well, I think that perhaps	18:58:58
3	"relatively little" is an overstatement.	18:59:01
4	BY MR. PICKETT:	18:59:06
5	Q. All right. Let's go to the last couple of	18:59:06
6	questions.	18:59:08
7	If Apple and Google couldn't call some of	18:59:15
8	the defendant employees, isn't it true they're more	18:59:21
9	likely to call other defendants' employees?	18:59:24
10	MR. GLACKIN: Objection, asked and	18:59:28
11	answered.	18:59:30
12	THE WITNESS: We've covered this, haven't	18:59:30
13	we? That's a hypothetical.	18:59:31
14	MR. GLACKIN: We're arguing about the same	18:59:33
15	thing we were arguing about at 10:00 this morning.	18:59:33
16	MR. PICKETT: The answer is?	18:59:37
17	THE WITNESS: I don't know that it's more	18:59:38
18	likely.	18:59:39
19	BY MR. PICKETT:	18:59:39
20	Q. You can't rule it out, though, can you?	18:59:39
21	A. I can't rule it out.	18:59:42
22	Q. And if you look at Figure 22, one follow-up	18:59:45
23	question on that. At page -- at page 67.	18:59:49
24	A. Yes.	19:00:04
25	Q. Is the undercompensation percentages	19:00:05

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1	equilibrium or not?	19:01:15
2	MR. GLACKIN: Objection, misstates the	19:01:16
3	testimony.	19:01:16
4	THE WITNESS: Well, I've tried to indicate	19:01:19
5	that the right way to think about it is if these	19:01:24
6	transactions are in search of a market equilibrium,	19:01:27
7	then all of the transactions are occurring outside	19:01:30
8	of market equilibrium levels.	19:01:33
9	BY MR. PICKETT:	19:01:35
10	Q. So -- so what is the compensation relative	19:01:35
11	to?	19:01:39
12	MR. GLACKIN: Objection, asked and	19:01:39
13	answered.	19:01:39
14	THE WITNESS: I told you that.	19:01:40
15	BY MR. PICKETT:	19:01:41
16	Q. It's not a market equilibrium, what is it?	19:01:41
17	A. It's -- it's the -- there are two sequences	19:01:43
18	of prices in search of the market equilibrium. One	19:01:45
19	sequence of prices go rapidly to the market	19:01:48
20	equilibrium, another sequence of prices go slowly to	19:01:52
21	market equilibrium. And the gap between those is	19:01:55
22	the -- is what is being reported here.	19:01:57
23	Q. If your conduct regressions came up with a	19:02:01
24	positive conduct coefficient, what would that tell	19:02:04
25	you about the model?	19:02:06

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1	A. Well, it would raise concerns about the	19:02:07
2	model.	19:02:09
3	Q. In what way?	19:02:09
4	A. The conceptual framework and the	19:02:10
5	appropriateness of the model. These things depend	19:02:13
6	upon the control variables that we have in the	19:02:16
7	equation. There's no question about that.	19:02:19
8	Q. So you're confident that your regression --	19:02:20
9	your conduct regression does not result in a	19:02:22
10	positive conduct coefficient?	19:02:24
11	A. Well, that's for sure. This regression	19:02:26
12	doesn't have a positive conduct regression.	19:02:30
13	MR. GLACKIN: We're done?	19:02:34
14	MR. PICKETT: That's it for now.	19:02:35
15	MR. GLACKIN: Wow.	19:02:40
16	MR. HINMAN: I just want to put on -- okay,	19:02:40
17	I'm going to put on the record that I think we have	19:02:41
18	some disagreement and we each request to reserve our	19:02:42
19	right with respect to the interpretation of the	19:02:45
20	stipulation and perhaps some of the instructions	19:02:47
21	that were given based on that.	19:02:48
22	MR. GLACKIN: Okay. That's fine. I	19:02:50
23	understand. But putting that issue aside, we're	19:02:51
24	done.	19:02:55
25	MR. PICKETT: Well, if I had more time, I'd	19:02:56

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```
 1  STATE OF CALIFORNIA       ) ss:

 2  COUNTY OF MARIN           )

 3

 4       I, ASHLEY SOEVYN, CSR No. 12019, do hereby

 5  certify:

 6       That the foregoing deposition testimony was

 7  taken before me at the time and place therein set

 8  forth and at which time the witness was administered

 9  the oath;

10       That the testimony of the witness and all

11  objections made by counsel at the time of the

12  examination were recorded stenographically by me,

13  and were thereafter transcribed under my direction

14  and supervision, and that the foregoing pages

15  contain a full, true and accurate record of all

16  proceedings and testimony to the best of my skill

17  and ability.

18       I further certify that I am neither counsel for

19  any party to said action, nor am I related to any

20  party to said action, nor am I in any way interested

21  in the outcome thereof.

22       IN THE WITNESS WHEREOF, I have transcribed my

    name this 29th day of October, 2012.

23

24

                        ASHLEY SOEVYN, CSR 12019

25
```

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Exhibit B

1   UNITED STATES DISTRICT COURT

2   NORTHERN DISTRICT OF CALIFORNIA, SAN JOSE DIVISION

3

4   --------------------------

5   IN RE: HIGH-TECH EMPLOYEE)

6   ANTITRUST LITIGATION   ) No. 11-CV-2509-LHK

7   --------------------------

8

9

10

11

12   VIDEOTAPED DEPOSITION OF MARK FICHTNER

13   San Francisco, California

14   Monday, October 15, 2012

15   Volume I

16

17

18

19

20   Reported by:

21   ASHLEY SOEVYN

22   CSR No. 12019

23   Job No. 1541278

24

25   PAGES 1 - 233

                                           Page 1

1   different employees' compensation would go within   10:47:59

2   the budget that you had to work with?   10:48:05

3   A.   A little less input into that. More input   10:48:08

4   into where they were on the list.   10:48:11

22   Q.   You also mentioned, I think that you   10:49:00

23   could -- or that people at Intel sometimes could   10:49:06

24   negotiate salaries -- sorry, negotiate raises at   10:49:09

25   other times of the year. Is that what you said?   10:49:13

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```
 1            MS. SHAVER:  Objection, assumes facts not     12:22:52

 2    in evidence.                                          12:22:53

 3            THE WITNESS:  I didn't calculate.             12:22:55

 4    BY MR. HINMAN:                                        12:22:57

 5       Q.   Well, you said -- didn't you tell me          12:22:57

 6    earlier that that was part of your decision to go to  12:22:59

 7    the Lab?                                              12:23:01

 8       A.   Yes, but I didn't do a financial             12:23:01

 9    calculation.                                          12:23:04

10       Q.   You put no value on that whatsoever?          12:23:04

11            MS. SHAVER:  Objection, mischaracterizes      12:23:06

12    testimony.                                            12:23:08

13            THE WITNESS:  I placed value on it.  I        12:23:08

14    didn't do a financial or a monetary calculation of   12:23:11

15    what that would be worth.                             12:23:14

16    BY MR. HINMAN:                                        12:23:15

17       Q.   So there was greater than zero, but you       12:23:15

18    didn't know or think about how much greater than      12:23:19

19    zero; is that right?                                  12:23:22

20       A.   I didn't do a numeric calculation.            12:23:23

21       Q.   Okay.  So when you left Marvell, is it        12:23:31

22    right to say -- well, do you know how much you were   12:23:34

23    making all in when you left Marvell?                  12:23:37

24            MS. SHAVER:  Objection, vague.                12:23:44

25            THE WITNESS:  Are you referring to salary     12:23:46
```

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1	THE WITNESS: Do I have personal -- or do I	13:43:04
2	have knowledge of who served on which boards?	13:43:05
3	BY MR. HINMAN:	13:43:12
4	Q. Do you have any personal knowledge of the	13:43:12
5	extent of any supposed agreement beyond the six that	13:43:15
6	are alleged in the complaint? Or even of those, for	13:43:21
7	that matter. Do you know anything about any of	13:43:24
8	that, personally?	13:43:32
9	A. I know of the eight contracts that were	13:43:35
10	list -- or the -- I know of the agreements that have	13:43:40
11	been mentioned in the complaint. And I know of the	13:43:42
12	relationships of the CEOs with each other.	13:43:46
13	Q. Is there any agreement alleged that Adobe	13:43:50
14	couldn't cold call Intel? Yes or no.	13:43:53
15	A. Not that I'm aware of.	13:43:59
16	Q. Okay. There is an agreement alleged that	13:44:02
17	Adobe couldn't cold call Apple, correct?	13:44:04
18	A. Alleged, yes.	13:44:06
19	Q. If Adobe needed to hire a software engineer	13:44:08
20	like yourself and they couldn't cold call into	13:44:10
21	Apple, doesn't that follow as a logical matter that	13:44:16
22	they are more likely to cold call into Intel?	13:44:18
23	MS. SHAVER: Objection to form.	13:44:23
24	THE WITNESS: I'm not sure. Your question	13:46:01
25	is because I have one less company to hire from,	13:46:06

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1	does that increase the chances that I might hire	13:46:10
2	from any particular company or recruit or cold call?	13:46:13
3	And I'm not sure.	13:46:19
4	BY MR. HINMAN:	13:46:21
5	Q. Okay. Well, let me ask it this way. If	13:46:21
6	there is a company that you can't cold call into,	13:46:24
7	doesn't that make it more likely that you're going	13:46:27
8	to cold call into any or all of the other companies	13:46:30
9	that are available to you?	13:46:38
10	MS. SHAVER: Same objection.	13:46:44
11	THE WITNESS: Again, you're using -- you	13:47:07
12	have one less company that you can hire or you can	13:47:12
13	recruit from. But that doesn't necessarily increase	13:47:14
14	or decrease the probability that you're going to	13:47:18
15	call any other particular company.	13:47:21
16	Q. Well, it's certainly not going to decrease	13:47:24
17	it, is it?	13:47:25
18	A. No.	13:47:26
19	Q. It might not affect it or it might increase	13:47:26
20	it; is that fair?	13:47:29
21	A. Yes.	13:47:33
22	Q. Is there anything about these seven	13:47:40
23	companies that you think that the employees are	13:47:44
24	particularly well-suited to work at the other	13:47:49
25	companies, as opposed to the scores of other	13:47:53

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```
 1        A.    If they were looking for an experienced        13:51:23

 2   candidate.                                                 13:51:25

 3        Q.    As opposed to an inexperienced one?            13:51:25

 4        A.    An inexperienced candidate, I think you        13:51:28

 5   might have a slightly different pool, including the        13:51:30

 6   colleges and universities that they go after.             13:51:34

 7        Q.    Okay.  But in terms of experienced             13:51:36

 8   candidates, I thought what I understood you to be          13:51:38

 9   saying is that the employees of these companies are       13:51:41

10   particularly attractive.                                  13:51:44

11        A.    Yes.                                           13:51:48

12        Q.    All right.  So if one of the sources of        13:51:49

13   attractive candidates is not available, wouldn't          13:51:56

14   that really tend to increase the incentive to search      13:52:00

15   in the other attractive employee pools?                   13:52:07

16             MS. SHAVER:  Objection, asked and               13:52:11

17   answered.                                                 13:52:15

18             THE WITNESS:  From a probability point of       13:52:16

19   view, yes.                                                13:52:23

20   BY MR. HINMAN:                                            13:52:27

21        Q.    Now, in terms of your job search in 2008, I    13:52:27

22   take it that you would claim in the case that you         13:52:40

23   didn't have to compete against Google employees for       13:52:42

24   that position at Intel because of the agreement           13:52:48

25   between those two companies; is that correct?            13:52:52
```

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▮   ▮   ▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮   ▮▮▮

▮   ▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮   ▮▮

3   MS. SHAVER: Objection, calls for   15:25:26

4   speculation.   15:25:28

5   THE WITNESS: I don't know.   15:25:30

6   BY MR. HINMAN: 15:25:31

▮   ▮   ▮▮▮▮▮▮▮▮▮▮▮▮▮▮   ▮▮

8   MS. SHAVER: Same objection.   15:25:35

9   THE WITNESS: I don't know.   15:25:36

10   BY MR. HINMAN: 15:25:38

11   Q.   Well, those were alternative choices that   15:25:38

12   you had, right?   15:25:40

13   A.   I don't agree with the premise.   15:25:53

14   Q.   You told me earlier today that you could   15:25:54

15   work at any company that had software, right? Yes   15:25:56

16   or no, you told me that?   15:26:11

17   A.   I can contribute to any company that   15:26:13

18   produces software, right.   15:26:14

19   Q.   And so at some level, any company that   15:26:16

20   produces software is in competition for, not you   15:26:22

21   personally, but employees like you, right?   15:26:26

22   MS. SHAVER: Object to form.   15:26:31

23   THE WITNESS: Again, I am not agreeing with   15:26:43

24   your word "compete."   15:26:45

25   BY MR. HINMAN: 15:27:03

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```
1   STATE OF CALIFORNIA      ) ss:

2   COUNTY OF MARIN          )

3

4       I, ASHLEY SOEVYN, CSR No. 12019, do hereby

5   certify:

6       That the foregoing deposition testimony was

7   taken before me at the time and place therein set

8   forth and at which time the witness was administered

9   the oath;

10      That the testimony of the witness and all

11  objections made by counsel at the time of the

12  examination were recorded stenographically by me,

13  and were thereafter transcribed under my direction

14  and supervision, and that the foregoing pages

15  contain a full, true and accurate record of all

16  proceedings and testimony to the best of my skill

17  and ability.

18      I further certify that I am neither counsel for

19  any party to said action, nor am I related to any

20  party to said action, nor am I in any way interested

21  in the outcome thereof.

22      IN THE WITNESS WHEREOF, I have transcribed my

23  name this 22nd day of October, 2012.

24

                        ASHLEY SOEVYN, CSR 12019

25
```

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Exhibit C

HIGHLY CONFIDENTIAL - ATTORNEYS' EYES ONLY

1   UNITED STATES DISTRICT COURT

2   NORTHERN DISTRICT OF CALIFORNIA, SAN JOSE DIVISION

3

4   --------------------------

5   IN RE: HIGH-TECH EMPLOYEE)

6   ANTITRUST LITIGATION   ) No. 11-CV-2509-LHK

7   --------------------------

8

9

10   HIGHLY CONFIDENTIAL - ATTORNEYS' EYES ONLY

11

12

13   VIDEOTAPED DEPOSITION OF SIDDHARTH HARIHARAN

14   San Francisco, California

15   Friday, October 12, 2012

16   Volume I

17

18

19

20   Reported by:

21   ASHLEY SOEVYN

22   CSR No. 12019

23   Job No. 1541277

24

25   PAGES 1 - 310

                                              Page 1

1	explored business opportunities. I don't know if I	14:28:36
2	ever got a response from them.	14:28:38
3	Q. So the business partnership possibilities	14:28:40
4	that you explored with Google those happened after	14:28:43
5	you founded InEarth?	14:28:47
6	A. I think so, yes.	14:28:52
7	Q. And so far those have not born any fruit?	14:28:53
8	A. I don't think so.	14:29:02
9	Q. If you were to work at Google, what	14:29:03
10	position do you think you would be qualified to	14:29:05
11	fill?	14:29:07
12	A. Well, I'm a software engineer with a ton of	14:29:07
13	experience with graphics, 3D math, talking about all	14:29:12
14	the things that Google does, so -- and I'm a	14:29:16
15	generalist, I probably be able to fill a lot of	14:29:23
16	positions there. I don't know exact positions, you	14:29:27
17	know, I'm not that strong in back end server work,	14:29:30
18	but I've done a lot of server work as well -- a lot	14:29:34
19	of -- because with Remoto and -- with a lot of	14:29:39
20	things, I've just done a lot of server work. They	14:29:42
21	do a lot of that as well. I don't know. There is	14:29:45
22	ton of positions I could fill.	14:29:48
23	Q. Would it concern you in applying for a	14:29:55
24	company like Google that they are not a video game	14:29:57
25	company?	14:30:00

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1	A. It has nothing to do with it. As a	14:30:01
2	software engineer, from the video game world, I can	14:30:04
3	work pretty much anywhere. In fact, that was the	14:30:07
4	case when -- well, it's been the case -- I know many	14:30:11
5	people that have worked in gaming that have jumped	14:30:15
6	to Adobe that have worked at Apple, worked at	14:30:17
7	Google. I know somebody who worked at NASA who came	14:30:22
8	to Lucasfilm.	14:30:25
9	So it's software engineering at the end of	14:30:27
10	the day. It's a lot easier, I think, for a gaming	14:30:30
11	engineer. A person that's worked on games to go	14:30:33
12	work for any of the large software companies because	14:30:40
13	the level of software engineering that game	14:30:43
14	developers do is very, very computationally	14:30:51
15	critical. And there's just so much commonality.	14:30:53
16	The only difference is -- do you know the difference	14:30:57
17	between a game and an application?	14:31:01
18	Q. Why don't you tell me.	14:31:07
19	A. An application is no real different from a	14:31:14
20	game. A game is just an interactive application.	14:31:17
21	It's a 3D -- it's could be a 3D application. It's	14:31:21
22	something with graphics, you know. A game didn't	14:31:24
23	even have graphics in the past. But there's no	14:31:25
24	difference between an application and a game.	14:31:25
25	How you monetize it -- your audience might	14:31:32

Page 180

1	be different. But there's no difference between an	14:31:37
2	application and a game. It's the same thing. Just	14:31:38
3	one happens -- you know, there are 3D applications,	14:31:40
4	too. You know, 3D Studio Math, Maya, you know,	14:31:44
5	those are applications with actual 3D geometry, a	14:31:45
6	lot of 3D math. You know, you're doing rendering	14:31:53
7	there. It has a lot of the same things. It's just	14:31:56
8	you're not sitting there playing with a joystick.	14:31:57
9	That's a completely different thing. That's a small	14:32:01
10	component at the end.	14:32:04
11	But there's no -- as far as computational	14:32:06
12	complexity, the type of coding that you do. Like,	14:32:07
13	if you put me in front of code that was written	14:32:12
14	by -- for Microsoft Word, I would being able to know	14:32:16
15	what it did with enough time, just like any engineer	14:32:20
16	would. So it's -- yeah, software engineering at the	14:32:25
17	end of the day.	14:32:29
■	■ ████████████████████	████
19	A. I really enjoyed working at Lucasfilm.	14:32:34
20	I -- it's really tough because it depends on what	14:32:38
21	time period you're talking about, too.	14:32:43
■	■ ████████████████████	████
■	████████	████
■	■ ████████ ████████	████
■	████████████████████	████

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 1   STATE OF CALIFORNIA      ) ss:

 2   COUNTY OF MARIN          )

 3

 4        I, ASHLEY SOEVYN, CSR No. 12019, do hereby

 5   certify:

 6        That the foregoing deposition testimony was

 7   taken before me at the time and place therein set

 8   forth and at which time the witness was administered

 9   the oath;

10        That the testimony of the witness and all

11   objections made by counsel at the time of the

12   examination were recorded stenographically by me,

13   and were thereafter transcribed under my direction

14   and supervision, and that the foregoing pages

15   contain a full, true and accurate record of all

16   proceedings and testimony to the best of my skill

17   and ability.

18        I further certify that I am neither counsel for

19   any party to said action, nor am I related to any

20   party to said action, nor am I in any way interested

21   in the outcome thereof.

22        IN THE WITNESS WHEREOF, I have transcribed my

23   name this 22nd day of October, 2012.

24

                        ASHLEY SOEVYN, CSR 12019

25
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Exhibit D

1   UNITED STATES DISTRICT COURT

2   NORTHERN DISTRICT OF CALIFORNIA, SAN JOSE DIVISION

3

4   --------------------------

5   IN RE: HIGH-TECH EMPLOYEE)

6   ANTITRUST LITIGATION   ) No. 11-CV-2509-LHK

7   --------------------------

8

9

10   HIGHLY CONFIDENTIAL - ATTORNEYS EYES ONLY

11

12

13   VIDEOTAPED DEPOSITION OF MICHAEL DEVINE

14   San Francisco, California

15   Wednesday, October 24, 2012

16   Volume I

17

18

19

20   Reported by:

21   ASHLEY SOEVYN

22   CSR No. 12019

23   JOB No. 1545479

24

25   PAGES 1 - 265

1	A. I would work in any market domain.	12:03:02
2	Q. What about -- what types of companies could	12:03:07
3	you work for?	12:03:12
4	A. Any type of company that needed software	12:03:13
5	engineering expertise. Or any company that was	12:03:18
6	interested in my expertise in any of these	12:03:27
7	particular market domains. There's this other thing	12:03:31
8	that some tech people do, which is technical product	12:03:34
9	management or we call them PMs at Microsoft.	12:03:38
10	Technical background, but they understand the	12:03:45
11	features and functions of the product space.	12:03:47
12	I could kind of work in both those areas.	12:03:55
13	Yeah, actually quite -- very flexible. So the	12:04:05
14	common threads are not restricting, they're an	12:04:14
15	advantage within that domain, but it's not that I	12:04:17
16	can't jump into anything that's completely foreign	12:04:20
17	to me and do it.	12:04:22
18	Q. You could work for any company that needs	12:04:30
19	software engineering with your skill set?	12:04:33
20	A. I think so.	12:04:36
21	Q. Looking at your resume, it appears that you	12:04:41
22	could work for technology companies and	12:04:46
23	non-technology companies?	12:04:50
24	A. Generally making technology for	12:04:57
25	non-technology companies. That's probably --	12:04:59

Page 96

1	depends on whether a company thinks its a technology	12:05:06
2	company or not.	12:05:10
3	Q. You worked for Merrill Lynch, for	12:05:10
4	example?	12:05:13
5	A. Yes. Which, depending on who you talk to,	12:05:14
6	is not a technology company. My boss thought it was	12:05:19
7	a technology company, actually. It is a matter of	12:05:22
8	perspective -- obviously they are a financial	12:05:30
9	company, but --	12:05:33
10	Q. Could you work for a financial company?	12:05:33
11	A. Most, yes.	12:05:44
12	Q. Doing the software engineering work that	12:05:47
13	you're qualified to do?	12:05:48
14	A. Yes. I could probably do mathematical	12:05:50
15	modeling work too, simulation. Actually, when I was	12:05:53
16	at Merrill Lynch, I created a new way of looking at	12:05:58
17	a bond valuation over time -- that wasn't used for a	12:06:09
18	long time. So that was a bit of an analytical thing	12:06:14
19	that would have been more of an analyst, bond	12:06:18
20	analyst kind of role. But again, my job title was	12:06:24
21	mathematical programmer, I think at that time.	12:06:30

Page 97

1 STATE OF CALIFORNIA   ) ss:

2 COUNTY OF MARIN   )

3

4   I, ASHLEY SOEVYN, CSR No. 12019, do hereby

5 certify:

6   That the foregoing deposition testimony was

7 taken before me at the time and place therein set

8 forth and at which time the witness was administered

9 the oath;

10   That the testimony of the witness and all

11 objections made by counsel at the time of the

12 examination were recorded stenographically by me,

13 and were thereafter transcribed under my direction

14 and supervision, and that the foregoing pages

15 contain a full, true and accurate record of all

16 proceedings and testimony to the best of my skill

17 and ability.

18   I further certify that I am neither counsel for

19 any party to said action, nor am I related to any

20 party to said action, nor am I in any way interested

21 in the outcome thereof.

       IN THE WITNESS WHEREOF, I have transcribed my

22 name this 31st day of October, 2012.

23

24

                    _____
                    ASHLEY SOEVYN, CSR 12019
25

                                        Page 265

Exhibit E

1   UNITED STATES DISTRICT COURT

2   NORTHERN DISTRICT OF CALIFORNIA, SAN JOSE DIVISION

3

4   --------------------------

5   IN RE: HIGH-TECH EMPLOYEE)

6   ANTITRUST LITIGATION   ) No. 11-CV-2509-LHK

7   --------------------------

8

9

10

11   -HIGHLY CONFIDENTIAL ATTORNEYS' EYES ONLY-

12

13   VIDEOTAPED DEPOSITION OF BRANDON MARSHALL

14   San Francisco, California

15   Monday, October 22, 2012

16   Volume I

17

18

19   Reported by:

20   ASHLEY SOEVYN

21   CSR No. 12019

22   Job No. 1541283

23

24

25   PAGES 1 - 341

                                          Page 1

1	responses, do you remember indicating in your	11:29:54
2	response how you learned about the Sandhill	11:29:56
3	position?	11:29:58
4	A. I don't know whether I indicated that in my	11:30:00
5	response.	11:30:02
6	Q. You don't recall?	11:30:04
7	A. I don't recall.	11:30:06
8	Q. As you sit here today, you don't recall	11:30:09
9	whether you learned of the Sandhill position through	11:30:12
10	an online recruitment website?	11:30:15
11	A. I don't recall.	11:30:20
12	Q. Have you ever used online recruitment	11:30:21
13	websites?	11:30:25
14	A. Oh, I've used online -- I guess so.	11:30:27
15	Depending on how you characterize "online	11:30:28
16	recruitment," I'd say yes.	11:30:32
17	Q. How would you characterize it?	11:30:33
18	A. Well, I will just tell you the websites	11:30:34
19	that I have used. I have used Dice, Monster, a long	11:30:37
20	time ago. Those ones I haven't used in a while.	11:30:42
21	Hot Jobs was one that was formally a big deal,	11:30:45
22	things like that.	11:30:49
23	Q. Can you list the other websites that you've	11:30:50
24	used?	11:30:52
25	A. More recently I used Indeed. It seems to	11:30:53

Page 122

1	be a good one nowadays.	11:30:57
2	Q. Anything else?	11:31:01
3	A. I probably have, but I can't think of any	11:31:02
4	others.	11:31:05
5	Q. Anything else that you've used before that	11:31:05
6	you haven't listed?	11:31:10
7	MR. GLACKIN: Asked and answered.	11:31:12
8	THE WITNESS: I probably have. I don't	11:31:15
9	remember.	11:31:17
10	BY MS. KAHN:	11:31:18
11	Q. And how do you use these websites?	11:31:18
12	A. Each website has its own interface you --	11:31:21
13	some of them -- I think some of them you upload your	11:31:24
14	resume. Oh, I'll tell you another one, LinkedIn.	11:31:29
15	Everybody uses LinkedIn, there you go.	11:31:33
16	Q. Thank you. Anything else comes to mind?	11:31:40
17	A. Just the fact that I'm on LinkedIn like	11:31:42
18	everyone else.	11:31:46
19	Q. So just walk me through how you would use	11:31:48
20	one of these websites. Let's say LinkedIn?	11:31:50
21	A. On LinkedIn, you have people you've worked	11:31:56
22	with in the past that you connect to and that you --	11:31:58
23	they are part of your network, like Facebook for job	11:32:04
24	networking and recruiters ping you on there, too.	11:32:10
25	Q. Recruiters what?	11:32:17

Page 123

```
 1   STATE OF CALIFORNIA      ) ss:

 2   COUNTY OF MARIN          )

 3

 4       I, ASHLEY SOEVYN, CSR No. 12019, do hereby

 5   certify:

 6       That the foregoing deposition testimony was

 7   taken before me at the time and place therein set

 8   forth and at which time the witness was administered

 9   the oath;

10       That the testimony of the witness and all

11   objections made by counsel at the time of the

12   examination were recorded stenographically by me,

13   and were thereafter transcribed under my direction

14   and supervision, and that the foregoing pages

15   contain a full, true and accurate record of all

16   proceedings and testimony to the best of my skill

17   and ability.

18       I further certify that I am neither counsel for

19   any party to said action, nor am I related to any

20   party to said action, nor am I in any way interested

21   in the outcome thereof.

22       IN THE WITNESS WHEREOF, I have transcribed my

23   name this 1st day of November, 2012.

24
                         ASHLEY SOEVYN, CSR 12019
25
```

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Exhibit F

HIGHLY CONFIDENTIAL - ATTORNEYS' EYES ONLY

1   UNITED STATES DISTRICT COURT

2   NORTHERN DISTRICT OF CALIFORNIA, SAN JOSE DIVISION

3

4   --------------------------

5   IN RE: HIGH-TECH EMPLOYEE)

6   ANTITRUST LITIGATION   ) No. 11-CV-2509-LHK

7   --------------------------

8

9

10   HIGHLY CONFIDENTIAL - ATTORNEYS' EYES ONLY

11

12

13   VIDEOTAPED DEPOSITION OF DANIEL STOVER

14   San Francisco, California

15   Monday, October 29, 2012

16   Volume I

17

18

19

20   Reported by:

21   ASHLEY SOEVYN

22   CSR No. 12019

23   JOB No. 1541285

24

25   PAGES 1 - 298

                                        Page 1

1	your own."	15:04:26
2	And then you responded, "Plaintiff used the	15:04:28
3	following sources of information regarding jobs or	15:04:31
4	compensation other than his own: Cold calls	15:04:33
5	received, co-workers, professional contacts, and	15:04:36
6	Internet researches" -- "resources such as	15:04:41
7	LinkedIn."	15:04:45
8	Is your response to interrogatory number 7	15:04:47
9	complete?	15:04:49
10	A. As far as I recall, yes.	15:05:00
11	Q. And which of these resources did you use to	15:05:04
12	look for job opportunities or keep abreast of job	15:05:08
13	opportunities?	15:05:12
14	A. Yeah, I think I definitely qualified as	15:05:15
15	staying abreast of job opportunities, so I liked	15:05:17
16	LinkedIn and great kind of interactions there. I've	15:05:21
17	already spoken about kind of an informal processes	15:05:28
18	that a co-worker can go through. So cold calls	15:05:32
19	received. I guess that would include both, you	15:05:38
20	know, e-mails I received from recruiters, whether	15:05:43
21	they are internal or external to a company or actual	15:05:47
22	phone calls which are less common. And professional	15:05:50
23	contacts I think I already covered. Discussed the	15:05:58
24	fact that, you know, you work with consultants all	15:06:01
25	the time, which is an exposure to companies outside	15:06:03

Page 176

1	you.	15:06:10
2	Q. While you were employed at Intuit -- excuse	15:06:11
3	me, did you use the sources that you just identified	15:06:17
4	to keep a breast of job opportunities?	15:06:22
5	A. I did.	15:06:27
6	Q. All right. And on the Internet resources	15:06:29
7	you mentioned LinkedIn. So while you were employed	15:06:31
8	at Intuit, you had a LinkedIn profile?	15:06:37
9	A. Yes, at some point I would have created	15:06:40
10	one.	15:06:42
11	Q. And you used LinkedIn to stay abreast of	15:06:43
12	job opportunities, while you were employed at	15:06:47
13	Intuit?	15:06:49
14	MS. LEEBOVE: Objection, misstates prior	15:06:53
15	testimony.	15:06:55
16	THE WITNESS: Yes.	15:06:56
17	BY MR. KIERNAN:	15:06:57
18	Q. And any other Internet resources, like job	15:06:57
19	boards, for example, Monster.com?	15:07:01
20	A. I'm sure I've looked at various job boards,	15:07:05
21	but I don't recall any specific sites.	15:07:10
22	Q. Do you recall ever visiting Monster.com?	15:07:17
23	A. While I was at Intuit, I don't recall	15:07:22
24	visiting it. I may have. I know at some point	15:07:24
25	early in my career, you know, I had an account	15:07:28

Page 177

1	there. But I don't specifically remember using	15:07:30
2	that while I was at Intuit.	15:07:34
3	Q. What about any other Internet resources,	15:07:46
4	other than LinkedIn that you used while you were	15:07:53
5	employed at Intuit?	15:07:55
6	A. Again, I'm sure there were a bunch. I	15:08:00
7	guess you could say Craigslist, maybe, although I	15:08:02
8	can't recall specifically if I used that. You know,	15:08:09
9	LinkedIn was most definitely the main resource that	15:08:11
10	I used and the one that I remember.	15:08:14
11	Q. Facebook? Did you use that to stay abreast	15:08:19
12	of job opportunities?	15:08:22
13	A. No.	15:08:24
14	Q. Dice.com?	15:08:26
15	A. Not that I recall.	15:08:28
16	Q. Have you ever used Dice.com?	15:08:31
17	A. I can't recall if I have or have not.	15:08:34
18	Q. Have you ever used Hotjobs?	15:08:39
19	A. I don't recall.	15:08:40
20	Q. Have you ever used Yahoo jobs?	15:08:41
21	A. I don't recall.	15:08:43
22	Q. Any industry specific sites -- websites?	15:08:51
23	A. I don't know how -- why they used LinkedIn	15:09:00
24	is, I mean it seems to be somewhat industry specific	15:09:03
25	to me. I could be wrong about that. But nothing	15:09:09

Page 178

1	A. Yeah, people that I would interact with on	16:20:04
2	a daily basis.	16:20:07
3	Q. And before we took a break, we were	16:20:10
4	discussing sources that you used to monitor job	16:20:13
5	opportunities. Now, I would like to focus on any	16:20:21
6	sources that you used to monitor compensation.	16:20:24
7	What -- what sources, if any, did you use	16:20:28
8	to monitor compensation while you were employed at	16:20:31
9	Intuit?	16:20:35
10	A. Primarily, in an internal way, people talk	16:20:43
11	to each other a bit. Salary trends and people	16:20:46
12	working in particular roles. An external way -- one	16:20:52
13	site I could cite is Glass Door. I remember looking	16:20:57
14	at -- although there were others. I don't remember	16:21:03
15	specifically what sites those were.	16:21:05
16	Q. Any other sources that you recall that you	16:21:14
17	used to monitor compensation while you were employed	16:21:16
18	at Intuit?	16:21:20
19	A. No specific examples.	16:21:31
20	Q. Any -- while you were employed at Intuit,	16:21:35
21	do you recall any sources of information that you	16:21:38
22	received about compensation while you were employed	16:21:44
23	at Intuit?	16:21:46
24	MS. LEEBOVE: Objection, vague.	16:21:48
25	THE WITNESS: Can you clarify "received,"	16:21:50

1	what you mean by that?	16:21:53
2	BY MR. KIERNAN:	16:21:55
3	Q. Well, what -- before we were talking about	16:21:55
4	any sources that you used to monitor, and you	16:21:56
5	mentioned discussions with co-workers and	16:22:02
6	Glassdoor.com. And I want to go a bit more broadly	16:22:05
7	to include any sources that you recall receiving	16:22:10
8	information about compensation of software	16:22:14
9	engineers' or web developers' jobs in the market	16:22:18
10	place.	16:22:22
11	MS. LEEBOVE: Objection, vague.	16:22:24
12	THE WITNESS: So I mean, if we cited kind	16:22:29
13	of informal discussions with co-workers and sites	16:22:31
14	which kind of aggregate data, like Glass Door,	16:22:35
15	people outside the company who you work with,	16:22:47
16	contractors, you know, how much they get paid an	16:22:50
17	hour. That's pretty much an indication of how much	16:22:58
18	money you can make as a contractor.	16:23:00
19	BY MR. KIERNAN:	16:23:06
20	Q. And then you were paid as a contractor	16:23:06
21	while you were employed at Intuit, correct?	16:23:11
22	A. For a short period, yes.	16:23:13
23	Q. With LT --	16:23:16
24	A. It was an LMNTL Holding.	16:23:17
25	Q. Thank you.	16:23:19

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1   State OF CALIFORNIA   ) ss:

2   COUNTY OF MARIN   )

3

4   I, ASHLEY SOEVYN, CSR No. 12019, do hereby

5   certify:

6   That the foregoing deposition testimony was

7   taken before me at the time and place therein set

8   forth and at which time the witness was administered

9   the oath;

10   That the testimony of the witness and all

11   objections made by counsel at the time of the

12   examination were recorded stenographically by me,

13   and were thereafter transcribed under my direction

14   and supervision, and that the foregoing pages

15   contain a full, true and accurate record of all

16   proceedings and testimony to the best of my skill

17   and ability.

18   I further certify that I am neither counsel for

19   any party to said action, nor am I related to any

20   party to said action, nor am I in any way interested

    in the outcome thereof.

21   IN THE WITNESS WHEREOF, I have transcribed my

22   name this 2nd day of November, 2012.

23

24

25
                                    ASHLEY SOEVYN, CSR 12019

Exhibit G

Let's Take the Con Out of Econometrics

Edward E. Leamer

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Let's Take the Con out of Econometrics

By Edward E. Leamer[*]

Econometricians would like to project the image of agricultural experimenters who divide a farm into a set of smaller plots of land and who select randomly the level of fertilizer to be used on each plot. If some plots are assigned a certain amount of fertilizer while others are assigned none, then the difference between the mean yield of the fertilized plots and the mean yield of the unfertilized plots is a measure of the effect of fertilizer on agricultural yields. The econometrician's humble job is only to determine if that difference is large enough to suggest a real effect of fertilizer, or is so small that it is more likely due to random variation.

This image of the applied econometrician's art is grossly misleading. I would like to suggest a more accurate one. The applied econometrician is like a farmer who notices that the yield is somewhat higher under trees where birds roost, and he uses this as evidence that bird droppings increase yields. However, when he presents this finding at the annual meeting of the American Ecological Association, another farmer in the audience objects that he used the same data but came up with the conclusion that moderate amounts of shade increase yields. A bright chap in the back of the room then observes that these two hypotheses are indistinguishable, given the available data. He mentions the phrase "identification problem," which, though no one knows quite what he means, is said with such authority that it is totally convincing. The meeting reconvenes in the halls and in the bars, with heated discussion whether this is the kind of work that merits promotion from Associate to Full Farmer; the Luminists strongly opposed to promotion and the Aviophiles equally strong in favor.

One should not jump to the conclusion that there is necessarily a substantive difference between drawing inferences from experimental as opposed to nonexperimental data. The images I have drawn are deliberately prejudicial. First, we had the experimental scientist with hair neatly combed, wide eyes peering out of horn-rimmed glasses, a white coat, and an electronic calculator for generating the random assignment of fertilizer treatment to plots of land. This seems to contrast sharply with the nonexperimental farmer with overalls, unkempt hair, and bird droppings on his boots. Another image, drawn by Orcutt, is even more damaging: "Doing econometrics is like trying to learn the laws of electricity by playing the radio." However, we need not now submit to the tyranny of images, as many of us have in the past.

I. Is Randomization Essential?

What is the real difference between these two settings? Randomization seems to be the answer. In the experimental setting, the fertilizer treatment is "randomly" assigned to plots of land, whereas in the other case nature did the assignment. Now it is the tyranny of words that we must resist. "Random" does not mean adequately mixed in *every* sample. It only means that on the average, the fertilizer treatments are adequately mixed. Randomization implies that the least squares estimator is "unbiased," but that definitely does not mean that for each sample the estimate is correct. Sometimes the estimate is too high, sometimes too low. I am reminded of the lawyer who remarked that "when I was a young man I lost many cases that I should have won, but when I grew older I won many that I should have lost, so on the average justice was done." In particular, it is possible for the randomized assignment to lead to exactly the same allocation as the nonrandom assignment,

namely, with treated plots of land all being under trees and with nontreated plots of land all being away from trees. I submit that, if this is the outcome of the randomization, then the randomized experiment and the nonrandomized experiment are exactly the same. Many econometricians would insist that there is a difference, because the randomized experiment generates "unbiased" estimates. But all this means is that, if this particular experiment yields a gross overestimate, some other experiment yields a gross underestimate.

Randomization thus does not assure that each and every experiment is "adequately mixed," but randomization does make "adequate mixing" probable. In order to make clear what I believe to be the true value of randomization, let me refer to the model

$$(1) \qquad Y_i = \alpha + \beta F_i + \gamma L_i + U_i,$$

where Y_i is the yield of plot i; F_i is the fertilizer assigned to plot i; L_i is the light falling on plot i; U_i is the unspecified influence on the yield of plot i, and where β, the fertilizer effect, is the object of the inferential exercise. We may suppose to begin the argument that the light level is expensive to measure and that it is decided to base an estimate of β initially only on measurement of Y_i and F_i. We may assume also that the natural experiment produces values for F_i, L_i, and U_i with expected values $E(U_i|F_i) = 0$ and $E(L_i|F_i) = r_0 + r_1 F_i$. In the more familiar parlance, it is assumed that the fertilizer level and the residual effects are uncorrelated, but the fertilizer level and the light level are possibly correlated. As every beginning econometrics student knows, if you omit from a model a variable which is correlated with included variables, bad things happen. These bad things are revealed to the econometrician by computing the conditional mean of Y given F but not L:

$$(2) \quad E(Y|F) = \alpha + \beta F + \gamma E(L|F)$$

$$= \alpha + \beta F + \gamma(r_0 + r_1 F)$$

$$\equiv (\alpha + \alpha^*) + (\beta + \beta^*)F,$$

where $\alpha^* = \gamma r_0$ and $\beta^* = \gamma r_1$. The linear regression of Y on F provides estimates of the parameters of the conditional distribution of Y given F, and in this case the regression coefficients are estimates not of α and β, but rather of $\alpha + \alpha^*$ and $\beta + \beta^*$. The parameters α^* and β^* measure the bias in the least squares estimates. This bias could be due to left-out variables, or to measurement errors in F, or to simultaneity.

When observing a nonexperiment, the bias parameters α^* and β^* can be thought to be small, but they cannot sensibly be treated as exact zeroes. The notion that the bias parameters are small can be captured by the assumption that α^* and β^* are drawn from a normal distribution with zero means and covariance matrix M. The model can then be written as $Y = \alpha + \beta F + \varepsilon$, where ε is the sum of three random variables: $U + \alpha^* + \beta^* F$. Because the error term ε is not spherical, the proper way to estimate α and β is generalized least squares. My 1974 article demonstrates that if (a, b) represent the least squares estimates of (α, β), then the generalized least squares estimates $(\hat{\alpha}, \hat{\beta})$ are also equal to (a, b):

$$(3) \qquad \begin{pmatrix} \hat{\alpha} \\ \hat{\beta} \end{pmatrix} = \begin{pmatrix} a \\ b \end{pmatrix},$$

and if S represents the sample covariance matrix for the least squares estimates, then the sample covariance matrix for $(\hat{\alpha}, \hat{\beta})$ is

$$(4) \qquad Var(\hat{\alpha}, \hat{\beta}) = S + M,$$

where M is the covariance matrix of (α^*, β^*).

The meaning of equation (3) is that unless one knows the direction of the bias, the possibility of bias does not call for any adjustment to the estimates. The possibility of bias does require an adjustment to the covariance matrix (4). The uncertainty is composed of two parts: the usual sampling uncertainty S plus the misspecification uncertainty M. As sample size grows, the sampling uncertainty S ever decreases, but the misspecification uncertainty M remains ever constant. The misspecification matrix M that we must add to the least squares variance

matrix is just the (prior) variance of the bias coefficients (α^*, β^*). If this variance matrix is small, the least squares bias is likely to be small. If M is large, it is correspondingly probable that (α^*, β^*) is large.

It would be a remarkable bootstrap if we could determine the extent of the misspecification from the data. The data in fact contain no information about the size of the bias, a point which is revealed by studying the likelihood function. The misspecification matrix M is therefore a pure prior concept. One must decide independent of the data how good the nonexperiment is.

The formal difference between a randomized experiment and a natural experiment is measured by the matrix M. If the treatment is randomized, the bias parameters (α^*, β^*) are exactly zero, or, equivalently, the matrix M is a zero matrix. If M is zero, the least squares estimates are consistent. If M is not zero, as in the natural experiment, there remains a fixed amount of specification uncertainty, independent of sample size.

There is therefore a sharp difference between inference from randomized experiments and inference from natural experiments. This seems to draw a sharp distinction between economics where randomized experiments are rare and "science" where experiments are routinely done. But the fact of the matter is that no one has ever designed an experiment that is free of bias, and no one can. As it turns out, the technician who was assigning fertilizer levels to plots of land, took his calculator into the fields, and when he was out in the sun, the calculator got heated up and generated large "random" numbers, which the technician took to mean no fertilizer; and when he stood under the shade of the trees, his cool calculator produced small numbers, and these plots received fertilizer.

You may object that this story is rather fanciful, but I need only make you think it is possible, to force you to set $M \neq 0$. Or if you think a computer can really produce random numbers (calculated by a mathematical formula and therefore perfectly predictable!), I will bring up mismeasurement of the fertilizer level, or human error in carrying out the computer instructions. Thus, the attempt to

randomize and the attempt to measure accurately ensures that M is small, but not zero, and the difference between scientific experiments and natural experiments is difference in degree, but not in kind. Admittedly however, the misspecification uncertainty in many experimental settings may be so small that it is well approximated by zero. This can very rarely be said in nonexperimental settings.

Examples may be ultimately convincing. There is a great deal of empirical knowledge in the science of astronomy, yet there are no experiments. Medical knowledge is another good example. I was struck by a headline in the January 5, 1982 *New York Times*: "Life Saving Benefits of Low-Cholesterol Diet Affirmed in *Rigorous* Study." The article describes a randomized experiment with a control group and a treated group. "Rigorous" is therefore interpreted as "randomized." As a matter of fact, there was a great deal of evidence suggesting a link between heart disease and diet before any experiments were performed on humans. There were cross-cultural comparisons and there were animal studies. Actually, the only reason for performing the randomized experiment was that someone believed there was pretty clear nonexperimental evidence to begin with. The nonexperimental evidence was, of course, inconclusive, which in my language means that the misspecification uncertainty M remained uncomfortably large. The fact that the Japanese have both less incidence of heart disease and also diets lower in cholesterol compared to Americans is not convincing evidence, because there are so many other factors that remain unaccounted for. The fact that pigs on a high cholesterol diet develop occluded arteries is also not convincing, because the similarity in physiology in pigs and humans can be questioned.

When the sampling uncertainty S gets small compared to the misspecification uncertainty M, it is time to look for other forms of evidence, experiments or nonexperiments. Suppose I am interested in measuring the width of a coin, and I provide rulers to a room of volunteers. After each volunteer has reported a measurement, I compute the mean and standard deviation, and I conclude that

the coin has width 1.325 millimeters with a standard error of .013. Since this amount of uncertainty is not to my liking, I propose to find three other rooms full of volunteers, thereby multiplying the sample size by four, and dividing the standard error in half. That is a silly way to get a more accurate measurement, because I have already reached the point where the sampling uncertainty S is very small compared with the misspecification uncertainty M. If I want to increase the true accuracy of my estimate, it is time for me to consider using a micrometer. So too in the case of diet and heart disease. Medical researchers had more or less exhausted the vein of nonexperimental evidence, and it became time to switch to the more expensive but richer vein of experimental evidence.

In economics, too, we are switching to experimental evidence. There are the laboratory experiments of Charles Plott and Vernon Smith (1978) and Smith (1980), and there are the field experiments such as the Seattle/ Denver income maintenance experiment. Another way to limit the misspecification error M is to gather different kinds of nonexperiments. Formally speaking, we will say that experiment 1 is qualitatively different from experiment 2 if the bias parameters (α_1^*, β_1^*) are distributed independently of the bias parameters (α_2^*, β_2^*). In that event, simple averaging of the data from the two experiments yields average bias parameters $(\alpha_1^* + \alpha_2^*, \ \beta_1^* + \beta_2^*)/2$ with misspecification variance matrix $M/2$, half as large as the (common) individual variances. Milton Friedman's study of the permanent income hypothesis is the best example of this that I know. Other examples are hard to come by. I believe we need to put much more effort into identifying qualitatively different and convincing kinds of evidence.

Parenthetically, I note that traditional econometric theory, which does not admit experimental bias, as a consequence also admits no "hard core" propositions. Demand curves can be shown to be positively sloped. Utility can be shown not to be maximized. Econometric evidence of a positively sloped demand curve would, as a matter of fact, be routinely explained in terms of simultaneity bias. If utility seems not to have been maxi-

mized, it is only that the econometrician has misspecified the utility function. The misspecification matrix M thus forms Imre Lakatos' "protective belt" which protects certain hard core propositions from falsification.

II. Is Control Essential?

The experimental scientist who notices that the fertilizer treatment is correlated with the light level can correct his experimental design. He can control the light level, or he can allocate the fertilizer treatment in such a way that the fertilizer level and the light level are not perfectly correlated.

The nonexperimental scientist by definition cannot control the levels of extraneous influences such as light. But he can control for the variable light level by including light in the estimating equation. Provided nature does not select values for light and values for fertilizer levels that are perfectly correlated, the effect of fertilizer on yields can be estimated with a multiple regression. The collinearity in naturally selected treatment variables may mean that the data evidence is weak, but it does not invalidate in any way the usual least squares estimates. Here, again, there is no essential difference between experimental and nonexperimental inference.

III. Are the Degrees of Freedom Inadequate with Nonexperimental Data?

As a substitute for experimental control, the nonexperimental researcher is obligated to include in the regression equation all variables that might have an important effect. The NBER data banks contain time-series data on 2,000 macroeconomic variables. A model explaining gross national product in terms of all these variables would face a severe degrees-of-freedom deficit since the number of annual observations is less than thirty. Though the number of observations of any phenomenon is clearly limited, the number of explanatory variables is logically unlimited. If a polynomial could have a degree as high as k, it would usually be admitted that the degree could be $k + 1$ as well. A theory that allows k lagged explanatory vari-
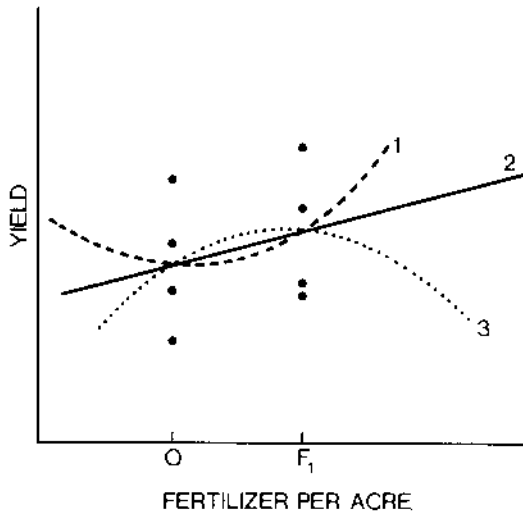
FIGURE 1. HYPOTHETICAL DATA AND
THREE ESTIMATED QUADRATIC FUNCTIONS

FIGURE 2. HYPOTHETICAL DATA AND
ESTIMATED QUADRATIC FUNCTION

ables would ordinarily allow $k+1$. If the level of money might affect GNP, then why not the number of presidential sneezes, or the size of the polar ice cap?

The number of explanatory variables is unlimited in a nonexperimental setting, but it is also unlimited in an experimental setting. Consider again the fertilizer example in which the farmer randomly decides either to apply F_1 pounds of fertilizer per acre or zero pounds, and obtains the data illustrated in Figure 1. These data admit the inference that fertilizer level F_1 produces higher yields than no fertilizer. But the farmer is interested in selecting the fertilizer level that maximizes profits. If it is hypothesized that yield is a linear function of the fertilizer intensity $Y = \alpha + \beta F + U$, then profits are

$$Profits = pA(\alpha + \beta F + U) - p_F AF,$$

where A is total acreage, p is the product price, and p_F is the price per pound of fertilizer. This profit function is linear in F with slope $A(\beta p - p_F)$. The farmer maximizes profits therefore by using no fertilizer if the price of fertilizer is high, $\beta p < p_F$, and using an unlimited amount of fertilizer if the price is low, $\beta p > p_F$. It is to be expected that you will find this answer unacceptable for one of

several reasons:

1) When the farmer tries to buy an unlimited amount of fertilizer, he will drive up its price, and the problem should be reformulated to make p_F a function of F.

2) Uncertainty in the fertilizer effect β causes uncertainty in profits, $Variance$ ($profits$) $= p^2 A^2 F^2 Var(\beta)$, and risk aversion will limit the level of fertilizer applied.

3) The yield function is nonlinear.

Economic theorists doubtless find reasons 1) and 2) compelling, but I suspect that the real reason farmers don't use huge amounts of fertilizer is that the marginal increase in the yield eventually decreases. Plants don't grow in fertilizer alone.

So let us suppose that yield is a quadratic function of fertilizer intensity, $Y = \alpha + \beta_1 F + \beta_2 F^2 + U$, and suppose we have only the data illustrated in Figure 1. Unfortunately, there are an infinite number of quadratic functions all of which fit the data equally well, three of which are drawn. If there were no other information available, we could conclude only that the yield is higher at F_1 than at zero. Formally speaking, there is an identification problem, which can be solved by altering the experimental design. The yield must be observed at a third point, as in Figure 2, where I have drawn the least squares estimated quadratic function and have indicated the fertilizer intensity F_m that maximizes the yield. I expect that most people would question whether these data admit the

FERTILIZER PER ACRE
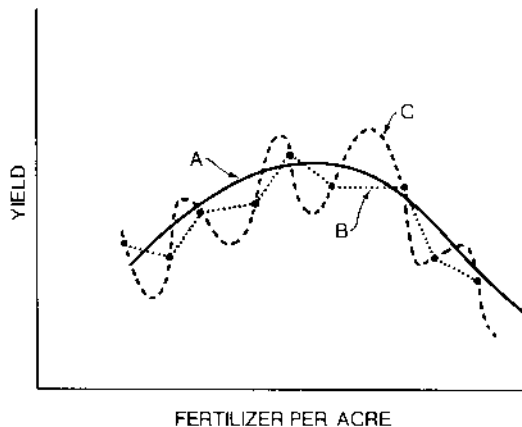
FIGURE 3. HYPOTHETICAL DATA AND
THREE ESTIMATED FUNCTIONS

inference that the yield is maximized at F_m. Actually, after inspection of this figure, I don't think anything can be inferred except that the yield at F_2 is higher than at F_1, which in turn is higher than at zero. Thus I don't believe the function is quadratic. If it is allowed to be a cubic then again there is an identification problem.

This kind of logic can be extended indefinitely. One can always find a set of observations that will make the inferences implied by a polynomial of degree p seem silly. This is true regardless of the degree p. Thus no model with a finite number of parameters is actually believed, whether the data are experimental or nonexperimental.

IV. Do We Need Prior Information?

A model with an infinite number of parameters will allow inference from a finite data set only if there is some prior information that effectively constrains the ranges of the parameters. Figure 3 depicts another hypothetical sequence of observations and three estimated relationships between yield and fertilizer. I believe the solid line A is a better representation of the relationship than either of the other two. The piecewise linear form B fits the data better, but I think this peculiar meandering function is highly unlikely on an a priori basis. Though B and C fit the data equally well, I believe that B is much more

likely than C. What I am revealing is the a priori opinion that the function is likely to be smooth and single peaked.

What should now be clear is that data alone cannot reveal the relationship between yield and fertilizer intensity. Data can reveal the yield at sampled values of fertilizer intensities, but in order to interpolate between these sampled values, we must resort to subjective prior information.

Economists have inherited from the physical sciences the myth that scientific inference is objective, and free of personal prejudice. This is utter nonsense. All knowledge is human belief; more accurately, human opinion. What often happens in the physical sciences is that there is a high degree of conformity of opinion. When this occurs, the opinion held by most is asserted to be an objective fact, and those who doubt it are labelled "nuts." But history is replete with examples of opinions losing majority status, with once-objective "truths" shrinking into the dark corners of social intercourse. To give a trivial example, coming now from California I am unsure whether fat ties or thin ties are aesthetically more pleasing.

The false idol of objectivity has done great damage to economic science. Theoretical econometricians have interpreted scientific objectivity to mean that an economist must identify exactly the variables in the model, the functional form, and the distribution of the errors. Given these assumptions, and given a data set, the econometric method produces an objective inference from a data set, unencumbered by the subjective opinions of the researcher.

This advice could be treated as ludicrous, except that it fills all the econometric textbooks. Fortunately, it is ignored by applied econometricians. The econometric art as it is practiced at the computer terminal involves fitting many, perhaps thousands, of statistical models. One or several that the researcher finds pleasing are selected for reporting purposes. This searching for a model is often well intentioned, but there can be no doubt that such a specification search invalidates the traditional theories of inference. The concepts of unbiasedness, consistency, efficiency, maximum-likelihood estimation,

in fact, all the concepts of traditional theory, utterly lose their meaning by the time an applied researcher pulls from the bramble of computer output the one thorn of a model he likes best, the one he chooses to portray as a rose. The consuming public is hardly fooled by this chicanery. The econometrician's shabby art is humorously and disparagingly labelled "data mining," "fishing," "grubbing," "number crunching." A joke evokes the Inquisition: "If you torture the data long enough, Nature will confess" (Coase). Another suggests methodological fickleness: "Econometricians, like artists, tend to fall in love with their models" (wag unknown). Or how about: "There are two things you are better off not watching in the making: sausages and econometric estimates."

This is a sad and decidedly unscientific state of affairs we find ourselves in. Hardly anyone takes data analyses seriously. Or perhaps more accurately, hardly anyone takes anyone else's data analyses seriously. Like elaborately plumed birds who have long since lost the ability to procreate but not the desire, we preen and strut and display our t-values.

If we want to make progress, the first step we must take is to discard the counterproductive goal of objective inference. The dictionary defines an inference as a logical conclusion based on a set of facts. The "facts" used for statistical inference about θ are first the data, symbolized by x, second a conditional probability density, known as a sampling distribution, $f(x|\theta)$, and, third, explicitly for a Bayesian and implicitly for "all others," a marginal or prior probability density function $f(\theta)$. Because both the sampling distribution and the prior distribution are actually *opinions* and not *facts*, a statistical inference is and must forever remain an *opinion*.

What is a fact? A fact is merely an opinion held by all, or at least held by a set of people you regard to be a close approximation to all.[1] For some that set includes only one

person. I myself have the opinion that Andrew Jackson was the sixteenth president of the United States. If many of my friends agree, I may take it to be a fact. Actually, I am most likely to regard it to be a fact if the authors of one or more books say it is so.

The difference between a fact and an opinion for purposes of decision making and inference is that when I use opinions, I get uncomfortable. I am not too uncomfortable with the opinion that error terms are normally distributed because most econometricians make use of that assumption. This observation has deluded me into thinking that the opinion that error terms are normal may be a fact, when I know deep inside that normal distributions are actually used only for convenience. In contrast, I am *quite* uncomfortable using a prior distribution, mostly I suspect because hardly anyone uses them. If convenient prior distributions were used as often as convenient sampling distributions, I suspect that I could be as easily deluded into thinking that prior distributions are facts as I have been into thinking that sampling distributions are facts.

To emphasize this hierarchy of statements, I display them in order: truths; facts; opinions; conventions. Note that I have added to the top of the order, the category truths. This will appeal to those of you who feel compelled to believe in such things. At the bottom are conventions. In practice, it may be difficult to distinguish a fact from a convention, but when facts are clearly unavailable, we must strongly resist the deceit or delusion that conventions can represent.

What troubles me about using opinions is their whimsical nature. Some mornings when I arise, I have the opinion that Raisin Bran is better than eggs. By the time I get to the kitchen, I may well decide on eggs, or oatmeal. I usually do recall that the sixteenth president distinguished himself. Sometimes I think he was Jackson; often I think he was Lincoln.

A data analysis is similar. Sometimes I take the error terms to be correlated, sometimes uncorrelated; sometimes normal and sometimes nonnormal; sometimes I include observations from the decade of the fifties, sometimes I exclude them; sometimes the

[1] This notion of "truth by consensus" is espoused by Thomas Kuhn (1962) and Michael Polanyi (1964). Oscar Wilde agrees by dissent: "A truth ceases to be true when more than one person believes it."

equation is linear and sometimes nonlinear; sometimes I control for variable z, sometimes I don't. Does it depend on what I had for breakfast?

As I see it, the fundamental problem facing econometrics is how adequately to control the whimsical character of inference, how sensibly to base inferences on opinions when facts are unavailable. At least a partial solution to this problem has already been formed by practicing econometricians. A common reporting style is to record the inferences implied by alternative sets of opinions. It is not unusual to find tables that show how an inference changes as variables are added to or deleted from the equation. This kind of sensitivity analysis reports special features of the mapping from the space of assumptions to the space of inferences. The defect of this style is that the coverage of assumptions is infinitesimal, in fact a zero volume set in the space of assumptions. What is needed instead is a more complete, but still economical way to report the mapping of assumptions into inferences. What I propose to do is to develop a correspondence between regions in the assumption space and regions in the inference space. I will report that all assumptions in a certain set lead to essentially the same inference. Or I will report that there are assumptions within the set under consideration that lead to radically different inferences. In the latter case, I will suspend inference and decision, or I will work harder to narrow the set of assumptions.

Thus what I am asserting is that the choice of a particular sampling distribution, or a particular prior distribution, is inherently whimsical. But statements such as "The sampling distribution is symmetric and unimodal" and "My prior is located at the origin" are not necessarily whimsical, and in certain circumstances do not make me uncomfortable.

To put this somewhat differently, an inference is not believable if it is fragile, if it can be reversed by minor changes in assumptions. As consumers of research, we correctly reserve judgment on an inference until it stands up to a study of fragility, usually by other researchers advocating opposite opinions. It is, however, much more efficient for individual researchers to perform their own sensitivity analyses, and we ought to be demanding much more complete and more honest reporting of the fragility of claimed inferences.

The job of a researcher is then to report economically and informatively the mapping from assumptions into inferences. In a slogan, "The mapping is the message." The mapping does not depend on opinions (assumptions), but reporting the mapping economically and informatively does. A researcher has to decide which assumptions or which sets of alternative assumptions are worth reporting. A researcher is therefore forced either to anticipate the opinions of his consuming public, or to recommend his own opinions. It is actually a good idea to do both, and a serious defect of current practice is that it concentrates excessively on convincing one's self and, as a consequence, fails to convince the general professional audience.

The whimsical character of econometric inference has been partially controlled in the past by an incomplete sensitivity analysis. It has also been controlled by the use of conventions. The normal distribution is now so common that there is nothing at all whimsical in its use. In some areas of study, the list of variables is partially conventional, often based on whatever list the first researcher happened to select. Even conventional prior distributions have been proposed and are used with nonnegligible frequency. I am referring to Robert Shiller's (1973) smoothness prior for distributed lag analysis and to Arthur Hoerl and Robert Kennard's (1970) ridge regression prior. It used to aggravate me that these methods seem to find public favor whereas overt and complete Bayesian methods such as my own proposals (1972) for distributed lag priors are generally ignored. However, there is a very good reason for this: the attempt to form a prior distribution from scratch involves an untold number of partly arbitrary decisions. The public is rightfully resistant to the whimsical inferences which result, but at the same time is receptive to the use of priors in ways that control the whimsy. Though the use of conventions does control the whimsy, it can do so at the cost of relevance. Inferences based

on Hoerl and Kennard's conventional "ridge regression" prior are usually irrelevant, because it is rarely sensible to take the prior to be spherical and located at the origin, and because a closer approximation to prior belief can be suspected to lead to substantially different inferences. In contrast, the conventional assumption of normality at least uses a distribution which usually cannot be ruled out altogether. Still, we may properly demand a demonstration that the inferences are insensitive to this distributional assumption.

A. *The Horizon Problem: Sherlock Holmes Inference*

Conventions are not to be ruled out altogether, however. One can go mad trying to report completely the mapping from assumptions into inferences since the space of assumptions is infinite dimensional. A formal statistical analysis therefore has to be done within the limits of a reasonable horizon. An informed convention can usefully limit this horizon. If it turned out that sensible neighborhoods of distributions around the normal distribution 99 times out of 100 produced the same inference, then we could all agree that there are other more important things to worry about, and we may properly adopt the convention of normality. The consistency of least squares estimates under wide sets of assumptions is used improperly as support for this convention, since the inferences from a given finite sample may nonetheless be quite sensitive to the normality assumption.[2]

The truly sharp distinction between inference from experimental and inference from nonexperimental data is that experimental inference sensibly admits a conventional horizon in a critical dimension, namely the choice of explanatory variables. If fertilizer is randomly assigned to plots of land, it is conventional to restrict attention to the relationship between yield and fertilizer, and

to proceed as if the model were perfectly specified, which in my notation means that the misspecification matrix M is the zero matrix. There is only a small risk that when you present your findings, someone will object that fertilizer and light level are correlated, and there is an even smaller risk that the conventional zero value for M will lead to inappropriate inferences. In contrast, it would be foolhardy to adopt such a limited horizon with nonexperimental data. But if you decide to include light level in your horizon, then why not rainfall; and if rainfall, then why not temperature; and if temperature, then why not soil depth, and if soil depth, then why not the soil grade; ad infinitum. Though this list is never ending, it can be made so long that a nonexperimental researcher can feel as comfortable as an experimental researcher that the risk of having his findings upset by an extension of the horizon is very low. The exact point where the list is terminated must be whimsical, but the inferences can be expected not to be sensitive to the termination point if the horizon is wide enough.

Still, the horizon within which we all do our statistical analyses has to be ultimately troublesome, since there is no formal way to know what inferential monsters lurk beyond our immediate field of vision. "Diagnostic" tests with explicit alternative hypotheses such as the Durbin-Watson test for first-order autocorrelation do not truly ask if the horizon should be extended, since first-order autocorrelation is explicitly identified and clearly in our field of vision. Diagnostic tests such as goodness-of-fit tests, without explicit alternative hypotheses, are useless since, if the sample size is large enough, any maintained hypothesis will be rejected (for example, no observed distribution is exactly normal). Such tests therefore degenerate into elaborate rituals for measuring the effective sample size.

The only way I know to ask the question whether the horizon is wide enough is to study the anomalies of the data. In the words of the physiologist, C. Bernard:

> A great surgeon performs operations for stones by a single method; later he

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[2] In particular, least squares estimates are completely sensitive to the independence assumption, since by choice of sample covariance matrix a generalized least squares estimate can be made to assume any value whatsoever (see my 1981 paper).

makes a statistical summary of deaths and recoveries, and he concludes from these statistics that the mortality law for this operation is two out of five. Well, I say that this ratio means literally nothing scientifically, and gives no certainty in performing the next operation. What really should be done, instead of gathering facts empirically, is to study them more accurately, each in its special determinism...by statistics, we get a conjecture of greater or less probability about a given case, but never any certainty, never any absolute determinism...only basing itself on experimental determinism can medicine become a true science.

[1927, pp. 137–38]

A study of the anomalies of the data is what I have called "Sherlock Holmes" inference, since Holmes turns statistical inference on its head: "It is a capital mistake to theorize before you have all the evidence. It biases the judgements." Statistical theory counsels us to begin with an elicitation of opinions about the sampling process and its parameters; the theory, in other words. After that, data may be studied in a purely mechanical way. Holmes warns that this biases the judgements, meaning that a theory constructed before seeing the facts can be disastrously inappropriate and psychologically difficult to discard. But if theories are constructed after having studied the data, it is difficult to establish by how much, if at all, the data favor the data-instigated hypothesis. For example, suppose I think that a certain coefficient ought to be positive, and my reaction to the anomalous result of a negative estimate is to find another variable to include in the equation so that the estimate is positive. Have I found evidence that the coefficient is positive? It would seem that we should require evidence that is more convincing than the traditional standard. I have proposed a method for discounting such evidence (1974). Initially, when you regress yield on fertilizer as in equation (2), you are required to assess a prior distribution for the experimental bias parameter β^*; that is, you must select the misspecification matrix M. Then, when the least squares estimate of β

turns out to be negative, and you decide to include in the equation the light level as well as the fertilizer level, you are obligated to form a prior for the light coefficient γ consistent with the prior for β^*, given that $\beta^* = \gamma r_1$, where r_1 is the regression coefficient of light on fertilizer.[3]

This method for discounting the output of exploratory data analysis requires a discipline that is lacking even in its author. It is consequently important that we reduce the risk of Holmesian discoveries by extending the horizon reasonably far. The degree of a polynomial or the order of a distributed lag need not be data instigated, since the horizon is easily extended to include high degrees and high orders. It is similarly wise to ask yourself before examining the data what you would do if the estimate of your favorite coefficient had the wrong sign. If that makes you think of a specific left-out variable, it is better to include it from the beginning.

Though it is wise to select a wide horizon to reduce the risk of Holmesian discoveries, it is mistaken then to analyze a data set as if the horizon were wide enough. Within the limits of a horizon, no revolutionary inference can be made, since all possible inferences are predicted in advance (admittedly, some with low probabilities). Within the horizon, inference and decision can be turned over completely to a computer. But the great human revolutionary discoveries are made when the horizon is extended for reasons that cannot be predicted in advance and cannot be computerized. If you wish to make such discoveries, you will have to poke at the horizon, and poke again.

V. An Example

This rhetoric is understandably tiring. Methodology, like sex, is better demonstrated than discussed, though often better anticipated than experienced. Accordingly, let me give you an example of what all this

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[3]In a randomized experiment with $r_1 = 0$, the constraint $\beta^* = \gamma r_1$ is irrelevant, and you are free to play these exploratory games without penalty. This is a very critical difference between randomized experiments and nonrandomized nonexperiments.

ranting and raving is about. I trust you will find it even better in the experience than in the anticipation. A problem of considerable policy importance is whether or not to have capital punishment. If capital punishment had no deterrent value, most of us would prefer not to impose such an irreversible punishment, though, for a significant minority, the pure joy of vengeance is reason enough. The deterrent value of capital punishment is, of course, an empirical issue. The unresolved debate over its effectiveness began when evolution was judging the survival value of the vengeance gene. Nature was unable to make a decisive judgment. Possibly econometricians can.

In Table 1, you will find a list of variables that are hypothesized to influence the murder rate.[4] The data to be examined are state-by-state murder rates in 1950. The variables are divided into three sets. There are four deterrent variables that characterize the criminal justice system, or in economic parlance, the expected out-of-pocket cost of crime. There are four economic variables that measure the opportunity cost of crime. And there are four social/environmental variables that possibly condition the taste for crime. This leaves unmeasured only the expected rewards for criminal behavior, though these are possibly related to the economic and social variables and are otherwise assumed not to vary from state to state.

A simple regression of the murder rate on all these variables leads to the conclusion that each additional execution deters thirteen murders, with a standard error of seven. That seems like such a healthy rate of return, we might want just to randomly draft executees from the population at large. This proposal would be unlikely to withstand the scrutiny of any macroeconomists who are skilled at finding rational expectations equilibria.

The issue I would like to address instead is whether this conclusion is fragile or not. Does it hold up if the list of variables in the model is changed? Individuals with different experiences and different training will find

[4] This material is taken from a study by a student of mine, Walter McManus (1982).

TABLE 1—VARIABLES USED IN THE ANALYSIS

a. Dependent Variable
M = Murder rate per 100,000, FBI estimate.

b. Independent Deterrent Variables
PC = (Conditional) Probability of conviction for murder given commission. Defined by $PC = C/Q$, where C = convictions for murder, $Q = M \cdot NS$, NS = state population. This is to correct for the fact that M is an estimate based on a sample from each state.
PX = (Conditional) Probability of execution given conviction (average number of executions 1946–50 divided by C).
T = Median time served in months for murder by prisoners released in 1951.
$XPOS$ = A dummy equal to 1 if $PX > 0$.

c. Independent Economic Variables
W = Median income of families in 1949.
X = Percent of families in 1949 with less than one-half W.
U = Unemployment rate.
LF = Labor force participation rate.

d. Independent Social and Environmental Variables
NW = Percent nonwhite.
AGE = Percent 15–24 years old.
URB = Percent urban.
$MALE$ = Percent male.
$FAMHO$ = Percent of families that are husband and wife both present families.
$SOUTH$ = A dummy equal to 1 for southern states (Alabama, Arkansas, Delaware, Florida, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia).

e. Weighting Variable
$SQRTNF$ = Square root of the population of the FBI-reporting region. Note that weighting is done by multiplying variables by $SQRTNF$.

f. Level of Observation
Observations are for 44 states, 35 executing and 9 nonexecuting. The executing states are: Alabama, Arizona, Arkansas, California, Colorado, Connecticut, Delaware, Florida, Illinois, Indiana, Kansas, Kentucky, Louisiana, Maryland, Massachusetts, Mississippi, Missouri, Nebraska, Nevada, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Virginia, Washington, West Virginia.
    The nonexecuting states are: Idaho, Maine, Minnesota, Montana, New Hampshire, Rhode Island, Utah, Wisconsin, Wyoming.

different subsets of the variables to be candidates for omission from the equation. Five different lists of doubtful variables are reported in Table 2. A right winger expects

TABLE 2—ALTERNATIVE PRIOR SPECIFICATIONS

Prior	PC	PX	T	XPOS	W	X	U	LF	NW	AGE	URB	MALE	FAMHO	SOUTH
Right Winger	I	I	I	*	D	D	D	D	D	D	D	D	D	D
Rational Maximizer	I	I	I	*	I	I	I	I	D	D	D	D	D	D
Eye-for-an-Eye	I	I	D	*	D	D	D	D	D	D	D	D	D	D
Bleeding Heart	D	D	D	*	I	I	I	I	D	D	D	D	D	D
Crime of Passion	D	D	D	*	I	I	I	I	I	I	I	I	I	I

Notes: 1) I indicates variables considered important by a researcher with the respective prior. Thus, every model considered by the researcher will include these variables. D indicates variables considered doubtful by the researcher. * indicates XPOS, the dummy equal to 1 for executing states. Each prior was pooled with the data two ways: one with XPOS treated as important, and one with it as doubtful.

2) With five basic priors and XPOS treated as doubtful or important by each, we get ten alternative prior specifications.

the punishment variables to have an effect, but treats all other variables as doubtful. He wants to know whether the data still favor the large deterrent effect, if he omits some of these doubtful variables. The rational maximizer takes the variables that measure the expected economic return of crime as important, but treats the taste variables as doubtful. The eye-for-an-eye prior treats all variables as doubtful except the probability of execution. An individual with the bleeding heart prior sees murder as the result of economic impoverishment. Finally, if murder is thought to be a crime of passion then the punishment variables are doubtful.

In Table 3, I have listed the extreme estimates that could be found by each of these groups of researchers. The right-winger minimum of -22.56 means that a regression of the murder rate data on the three punishment variables and a suitably selected linear combination of the other variables yields an estimate of the deterrent effect equal to 22.56 lives per execution. It is possible also to find an estimate of $-.86$. Anything between these two extremes can be similarly obtained; but no estimate outside this interval can be generated no matter how the doubtful variables are manipulated (linearly). Thus the right winger can report that the inference from this data set that executions deter murders is not fragile. The rational maximizer similarly finds that conclusion insensitive to choice of model, but the other three priors allow execution actually to encourage murder, possibly by a brutalizing effect on society.

TABLE 3—EXTREME ESTIMATES OF THE EFFECT OF EXECUTIONS ON MURDERS

Prior	Minimum Estimate	Maximum Estimate
Right Winger	-22.56	$-.86$
Rational Maximizer	-15.91	-10.24
Eye-for-an-Eye	-28.66	1.91
Bleeding Heart	-25.59	12.37
Crime of Passion	-17.32	4.10

Note: Least squares is -13.22 with a standard error of 7.2.

I come away from a study of Table 3 with the feeling that any inference from these data about the deterrent effect of capital punishment is too fragile to be believed. It is possible credibly to narrow the set of assumptions, but I do not think that a credibly large set of alternative assumptions will lead to a sharp set of estimates. In another paper (1982), I found a narrower set of priors still leads to inconclusive inferences. And I have ignored the important simultaneity issue (the death penalty may have been imposed in crime ridden states to deter murder) which is often a source of great inferential fragility.

VI. Conclusions

After three decades of churning out estimates, the econometrics club finds itself under critical scrutiny and faces incredulity as never before. Fischer Black writes of "The Trouble with Econometric Models." David

Hendry queries "Econometrics: Alchemy or Science?" John W. Pratt and Robert Schlaifer question our understanding of "The Nature and Discovery of Structure." And Christopher Sims suggests blending "Macroeconomics and Reality."

It is apparent that I too am troubled by the fumes which leak from our computing centers. I believe serious attention to two words would sweeten the atmosphere of econometric discourse. These are whimsy and fragility. In order to draw inferences from data as described by econometric texts, it is necessary to make whimsical assumptions. The professional audience consequently and properly withholds belief until an inference is shown to be adequately insensitive to the choice of assumptions. The haphazard way we individually and collectively study the fragility of inferences leaves most of us unconvinced that any inference is believable. If we are to make effective use of our scarce data resource, it is therefore important that we study fragility in a much more systematic way. If it turns out that almost all inferences from economic data are fragile, I suppose we shall have to revert to our old methods lest we lose our customers in government, business, and on the boardwalk at Atlantic City.

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Exhibit H

Tantalus on the Road to Asymptopia

Edward E. Leamer

My first reaction to "The Credibility Revolution in Empirical Economics," authored by Joshua D. Angrist and Jörn-Steffen Pischke, was: Wow! This paper makes a stunningly good case for relying on purposefully randomized or accidentally randomized experiments to relieve the doubts that afflict inferences from nonexperimental data. On further reflection, I realized that I may have been overcome with irrational exuberance. Moreover, with this great honor bestowed on my "con" article, I couldn't easily throw this child of mine overboard.

We economists trudge relentlessly toward Asymptopia, where data are unlimited and estimates are consistent, where the laws of large numbers apply perfectly and where the full intricacies of the economy are completely revealed. But it's a frustrating journey, since, no matter how far we travel, Asymptopia remains infinitely far away. Worst of all, when we feel pumped up with our progress, a tectonic shift can occur, like the Panic of 2008, making it seem as though our long journey has left us disappointingly close to the State of Complete Ignorance whence we began.

The pointlessness of much of our daily activity makes us receptive when the Priests of our tribe ring the bells and announce a shortened path to Asymptopia. (Remember the Cowles Foundation offering asymptotic properties of simultaneous equations estimates and structural parameters?) We may listen, but we don't hear, when the Priests warn that the new direction is only for those with Faith, those with complete belief in the Assumptions of the Path. It often takes years down the Path, but sooner or later, someone articulates the concerns that gnaw away in each of

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us and asks if the Assumptions are valid. (T. C. Liu (1960) and Christopher Sims (1980) were the ones who proclaimed that the Cowles Emperor had no clothes.) Small seeds of doubt in each of us inevitably turn to despair and we abandon that direction and seek another.

Two of the latest products-to-end-all-suffering are nonparametric estimation and consistent standard errors, which promise results without assumptions, as if we were already in Asymptopia where data are so plentiful that no assumptions are needed. But like procedures that rely explicitly on assumptions, these new methods work well in the circumstances in which explicit or hidden assumptions hold tolerably well and poorly otherwise. By disguising the assumptions on which nonparametric methods and consistent standard errors rely, the purveyors of these methods have made it impossible to have an intelligible conversation about the circumstances in which their gimmicks do not work well and ought not to be used. As for me, I prefer to carry parameters on my journey so I know where I am and where I am going, not travel stoned on the latest euphoria drug.

This is a story of Tantalus, grasping for knowledge that remains always beyond reach. In Greek mythology Tantalus was favored among all mortals by being asked to dine with the gods. But he misbehaved—some say by trying to take divine food back to the mortals, some say by inviting the gods to a dinner for which Tantalus boiled his son and served him as the main dish. Whatever the etiquette faux pas, Tantalus was punished by being immersed up to his neck in water. When he bowed his head to drink, the water drained away, and when he stretched up to eat the fruit hanging above him, wind would blow it out of reach. It would be much healthier for all of us if we could accept our fate, recognize that perfect knowledge will be forever beyond our reach and find happiness with what we have. If we stopped grasping for the apple of Asymptopia, we would discover that our pool of Tantalus is full of small but enjoyable insights and wisdom.

Can we economists agree that it is extremely hard work to squeeze truths from our data sets and what we genuinely understand will remain uncomfortably limited? We need words in our methodological vocabulary to express the limits. We need sensitivity analyses to make those limits transparent. Those who think otherwise should be required to wear a scarlet-letter O around their necks, for "overconfidence." Angrist and Pischke obviously know this. Their paper is peppered with concerns about quasi-experiments and with criticisms of instrumental variables thoughtlessly chosen. I think we would make progress if we stopped using the words "instrumental variables" and used instead "surrogates"— meaning surrogates for the experiment that we wish we could have conducted. The psychological power of the vocabulary requires a "surrogate" to be chosen with much greater care than an "instrument."

As Angrist and Pischke persuasively argue, either purposefully randomized experiments or accidentally randomized "natural" experiments can be extremely helpful, but Angrist and Pischke seem to me to overstate the potential benefits of the approach. Since hard and inconclusive thought is needed to transfer the

results learned from randomized experiments into other domains, there must therefore remain uncertainty and ambiguity about the breadth of application of any findings from randomized experiments. For example, how does Card's (1990) study of the effect on the Miami labor market of the Mariel boatlift of 125,000 Cuban refugees in 1980 inform us of the effects of a 2000 mile wall along the southern border of the United States? Thoughts are also needed to justify the choice of instrumental variables, and a critical element of doubt and ambiguity necessarily afflicts any instrumental variables estimate. (You and I know that truly consistent estimators are imagined, not real.) Angrist and Pischke understand this. But their students and their students' students may come to think that it is enough to wave a clove of garlic and chant "randomization" to solve all our problems just as an earlier cohort of econometricians have acted as if it were enough to chant "instrumental variable."

I will begin this comment with some thoughts about the inevitable limits of randomization, and the need for sensitivity analysis in this area, as in all areas of applied empirical work. To be provocative, I will argue here that the financial catastrophe that we have just experienced powerfully illustrates a reason why extrapolating from natural experiments will inevitably be hazardous. The misinterpretation of historical data that led rating agencies, investors, and even myself to guess that home prices would decline very little and default rates would be tolerable even in a severe recession should serve as a caution for all applied econometrics. I will also offer some thoughts about how the difficulties of applied econometric work cannot be evaded with econometric innovations, offering some under-recognized difficulties with instrumental variables and robust standard errors as examples. I conclude with some comments about the shortcomings of an experimentalist paradigm as applied to macroeconomics, and with some warnings about the willingness of applied economists to apply push-button methodologies without sufficient hard thought regarding their applicability and shortcomings.

Randomization Is Not Enough

Angrist and Pischke offer a compelling argument that randomization is one large step in the right direction. Which it is! But like all the other large steps we have already taken, this one doesn't get us where we want to be.

In addition to randomized treatments, most scientific experiments also have controls over the important confounding effects. These controls are needed to improve the accuracy of the estimate of the treatment effect and also to determine clearly the range of circumstances over which the estimate applies. (In a laboratory vacuum, we would find that a feather falls as fast as a bowling ball. In the real world with air, wind, and humidity, all bets are off, pending further study.)

In place of experimental controls, economists can, should, and usually do include control variables in their estimated equations, whether the data are

nonexperimental or experimental. To make my point about the effect of these controls it will be helpful to refer to the prototypical model:

$$y_t = \alpha + (\beta_0 + \beta_1' \mathbf{z}_t) x_t + \theta' \mathbf{w}_t + \varepsilon_t,$$

where x is the treatment, y the response, $\mathbf{z}$ is a set of interactive confounders, $\mathbf{w}$ is a set of additive confounders, where ε stands for all the other unnamed, unmeasured effects which we sheepishly assume behaves like a random variable, distributed independently of the observables. Here $(\beta_0 + \beta_1' \mathbf{z}_t)$ is the variable treatment effect that we wish to estimate. One set of problems is caused by the additive confounding variables $\mathbf{w}$, which can be uncomfortably numerous. Another set of problems is caused by the interactive confounding variables $\mathbf{z}$, which may include features of the experimental design as well as characteristics of the subjects.

Consider first the problem of the additive confounders. We have been taught that experimental randomization of the treatment eliminates the requirement to include additive controls in the equation because the correlation between the controls and the treatment is zero by design and regression estimates with or without the controls are unbiased, indeed identical. That's true in Asymptopia, but it's not true here in the Land of the Finite Sample where correlation is an ever-present fact of life and where issues of sensitivity of conclusions to assumptions can arise even with randomized treatments if the correlations between the randomized treatment and the additive confounders, by chance, are high enough.

Indeed, if the number of additive confounding variables is equal to or larger than the number of observations, any treatment x, randomized or not, will be perfectly collinear with the confounding variables (the undersized sample problem). Then, to estimate the treatment effect, we would need to make judgments about which of the confounding variables to exclude. That would ordinarily require a sensitivity analysis, unless through Divine revelation economists were told exactly which controls to include and which to exclude. Though the number of randomized trials may be large, an important sensitivity question can still arise because the number of confounding variables can be increased without limit by using lagged values and nonlinear forms. In other words, if you cannot commit to some notion of smoothness of the functional form of the confounders and some notion of limited or smooth time delays in response, you will not be able to estimate the treatment effect even with a randomized experiment, unless experimental controls keep the confounding variables constant or Divine inspiration allows you to omit some of the variables.

You are free to dismiss the preceding paragraph as making a mountain out of a molehill. By reducing the realized correlation between the treatment and the controls, randomization allows a larger set of additive control variables to be included before we confront the sensitivity issues caused by collinearity. For that reason, though correlation between the treatment and the confounders with nonexperimental data is a *huge* problem, it is much less important when the treatment is randomized. With that problem neutralized, concern shifts elsewhere.

The big problem with randomized experiments is not additive confounders; it's the interactive confounders. This is the heterogeneity issue that especially concerns Heckman (1992) and Deaton (2008) who emphasized the need to study "causal mechanisms," which I am summarizing in terms of the interactive **z** variables. Angrist and Pischke completely understand this point, but they seem inappropriately dismissive when they accurately explain "extrapolation of causal effects to new settings is always speculative," which is true, but the extrapolation speculation is more transparent and more worrisome in the experimental case than in the nonexperimental case.

After all, in nonexperimental nonrandomized settings, when judicious choice of additive confounders allows one to obtain just about any estimate of the treatment effect, there is little reason to worry about "extrapolation of causal effects to new settings." What's to extrapolate anyway? Our lack of knowledge? Greater concern about extrapolation is thus an indicator of the progress that comes from randomization.

When the randomization is accidental, we may pretend that the instrumental variables estimator is consistent, but we all know that the assumptions that justify that conclusion cannot possibly hold exactly. Those who use instrumental variables would do well to anticipate the inevitable barrage of questions about the appropriateness of their instruments. Ever-present asymptotic bias casts a large dark shadow on instrumental variables estimates and is what limits the applicability of the estimate even to the setting that is observed, not to mention extrapolation to new settings. In addition, small sample bias of instrumental variables estimators, even in the consistent case, is a huge neglected problem with practice, made worse by the existence of multiple weak instruments. This seems to be one of the points of the Angrist and Pischke paper—purposeful randomization is better than accidental randomization.

But when the randomization is purposeful, a whole new set of issues arises—experimental contamination—which is much more serious with human subjects in a social system than with chemicals mixed in beakers or parts assembled into mechanical structures. Anyone who designs an experiment in economics would do well to anticipate the inevitable barrage of questions regarding the valid transference of things learned in the lab (one value of z) into the real world (a different value of z).

With interactive confounders explicitly included, the overall treatment effect $\beta_0 + \boldsymbol{\beta}'\mathbf{z}_t$ is not a number but a variable that depends on the confounding effects. Absent observation of the interactive compounding effects **z**, what is estimated is some kind of average treatment effect which is called by Imbens and Angrist (1994) a "Local Average Treatment Effect," which is a little like the lawyer who explained that when he was a young man he lost many cases he should have won but as he grew older he won many that he should have lost, so that on the average justice was done. In other words, if you act as if the treatment effect is a random variable by substituting β_t for $\beta_0 + \boldsymbol{\beta}'\mathbf{z}_t$, the notation inappropriately relieves you of the heavy burden of considering what are the interactive confounders and finding some way to measure them. Less elliptically, absent observation of **z**, the estimated treatment

effect should be transferred *only* into those settings in which the confounding interactive variables have values close to the mean values in the experiment. If little thought has gone into identifying these possible confounders, it seems probable that little thought will be given to the limited applicability of the results in other settings. This is the error made by the bond rating agencies in the recent financial crash—they transferred findings from one historical experience to a domain in which they no longer applied because, I will suggest, social confounders were not included. More on this below.

Sensitivity Analysis and Sensitivity Conversations are What We Need

I thus stand by the view in my 1983 essay that econometric theory promises more than it can deliver, because it requires a complete commitment to assumptions that are actually only half-heartedly maintained. The only way to create credible inferences with doubtful assumptions is to perform a sensitivity analysis that separates the fragile inferences from the sturdy ones: those that depend substantially on the doubtful assumptions and those that do not. Since I wrote my "con in econometrics" challenge much progress has been made in economic theory and in econometric theory and in experimental design, but there has been little progress technically or procedurally on this subject of sensitivity analyses in econometrics. Most authors still support their conclusions with the results implied by several models, and they leave the rest of us wondering how hard they had to work to find their favorite outcomes and how sure we have to be about the instrumental variables assumptions with accidentally randomized treatments and about the extent of the experimental bias with purposefully randomized treatments. It's like a court of law in which we hear only the experts on the plaintiff's side, but are wise enough to know that there are abundant arguments for the defense.

I have been making this point in the econometrics sphere since before I wrote *Specification Searches: Ad Hoc Inference with Nonexperimental Data* in 1978.[1] That book was stimulated by my observation of economists at work who routinely pass their data through the filters of many models and then choose a few results for reporting purposes. The range of models economists are willing to explore creates ambiguity in the inferences that can properly be drawn from our data, and I have been recommending mathematical methods of sensitivity analysis that are intended to determine the limits of that ambiguity.

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[1] Parenthetically, if you are alert, you might have been unsettled by the use of the word "with" in my title: *Ad Hoc Inference with Nonexperimental Data,* since inferences are made *with tools* but *from data.* That is my very subtle way of suggesting that knowledge is created by an interactive exploratory process, quite unlike the preprogrammed estimation dictated by traditional econometric theory.

The language that I used to make the case for sensitivity analysis seems not to have penetrated the consciousness of economists. What I called "extreme bounds analysis" in my 1983 essay is a simple example that is the best-known approach, though poorly understood and inappropriately applied. Extreme bounds analysis is not an "ad hoc but intuitive approach," as described by Angrist and Pischke. It is a solution to a clearly and precisely defined sensitivity question, which is to determine the range of estimates that the data could support given a precisely defined range of assumptions about the prior distribution. It's a correspondence between the assumption space and the estimation space. Incidentally, if you could see the wisdom in finding the range of estimates that the data allow, I would work to provide tools that identify the range of *t*-values, a more important measure of the fragility of the inferences.

A prior distribution is a foreign concept for most economists, and I tried to create a bridge between the logic of the analysis and its application by expressing the bounds in language that most economists could understand. Here it is: Include in the equation the treatment variable and a single linear combination of the additive controls. Then find the linear combination of controls that provides the greatest estimated treatment effect and the linear combination that provides the smallest estimated treatment effect. That corresponds to the range of estimates that can be obtained when it is known that the controls are doubtful (zero being the most likely estimate, a priori) but there is complete ambiguity about the probable importance of the variables, arbitrary scales, and arbitrary coordinate systems. What is ad hoc are the follow-on methods, for example, computing the standard errors of the bounds or reporting a distribution of estimates as in Sala-i-Martin (1997).

A culture that insists on statistically significant estimates is not naturally receptive to another reason our data are uninformative (too much dependence on arbitrary assumptions). One reason these methods are rarely used is their honesty seems destructive; or, to put it another way, a fanatical commitment to fanciful formal models is often needed to create the appearance of progress. But we need to change the culture and regard the finding of "no persuasive evidence in these data" on the same footing as a "statistically significant and sturdy estimate." Keep in mind that the sensitivity correspondence between assumptions and inferences can go in either direction. We can ask what set of inferences corresponds to a particular set of assumptions, but we can also ask what assumptions are needed to support a hoped-for inference. That is exactly what an economic theorem does. The intellectual value of the Factor Price Equalization Theorem does not derive from its truthfulness; it's value comes from the fact that it provides a minimal set of assumptions that imply Factor Price Equalization, thus focusing attention on *why* factor prices are not equalized.

To those of you who do data analysis, I thus pose two questions that I think every empirical enterprise should be able to answer: What feature of the data leads to that conclusion? What set of assumptions is essential to support that inference?

The Troubles on Wall Street and Three-Valued Logic

With the ashes of the mathematical models used to rate mortgage-backed securities still smoldering on Wall Street, now is an ideal time to revisit the sensitivity issues. Justin Fox (2009) suggests in his title *The Myth of the Rational Market, A History of Risk, Reward, and Delusion on Wall Street* that we have been making a modeling error and that the problems lie in the assumption of rational actors, which presumably can be remedied by business-as-usual after adding a "behavioral" variable or two into the model. I think the roots of the problem are deeper, calling for a change in the way we do business and calling for a book that might be titled: *The Myth of the Data Generating Process: A History of Delusion in Academia*. Rationality of financial markets is a pretty straightforward consequence of the assumption that financial returns are drawn from a "data generating process" whose properties are apparent to experienced investors and econometricians, after studying the historical data. If we don't know the data generating process, then the efficient markets edifice falls apart. Even simple-minded finance ideas, like the benefits from diversification, become suspect if we cannot reliably assess predictive means, variances, and covariances.

But it isn't just finance that rests on this myth of a data-generating process. It is the whole edifice of empirical economics. Let's face it. The evolving, innovating, self-organizing, self-healing human system we call the economy is not well described by a fictional "data-generating process." The point of the sensitivity analyses that I have been advocating begins with the admission that the historical data are compatible with countless alternative data-generating models. If there is one, the best we can do is to get close; we are never going to know it.

Confronted with our collective colossal failure to anticipate the problems with mortgage-backed securities, we economists have been stampeding shamelessly back to Keynesian thinking about macroeconomics, scurrying to reread Keynes' (1936) *General Theory of Employment, Interest and Money*. We would do well to go back a little further in time to 1921 when both Keynes' *Treatise on Probability* and Frank Knight's *Risk, Uncertainty and Profit* were published. Both of these books are about the myth of the data generating process. Both deal with the limits of the expected utility maximization paradigm. Both serve as foundations for the arguments in favor of sensitivity analysis in my "con" paper. Both are about "three-valued logic."

Here is how three-valued logic works. Suppose you can confidently determine that it is a good idea to bring your umbrella if the chance of rain is 10 percent or higher, but carrying the umbrella involves more cost than expected benefit if the chance of rain is less. When the data point clearly to a probability either in excess of 10 percent or less than 10 percent, then we are in a world of Knightian risk in which the decision can be based on expected utility maximization. But suppose there is one model that suggests the probability is 15 percent while another equally good model suggests the probability is 5 percent. Then we are in a world of Knightian

uncertainty in which expected utility maximization doesn't produce a decision. When any number between 0.05 and 0.15 is an equally good[2] assessment of the chance of rain we are dealing with epistemic probabilities that are not numbers but intervals, in the spirit of Keynes (1921). While the decision is two-valued—you either take your umbrella or you don't—the state of mind is three-valued: yes (take the umbrella), no (leave it behind), or I don't know. The point of adopting three-valued logic like Keynes and Knight is to encourage us to think clearly about the limits of our knowledge and the limits of the expected utility maximization paradigm. With all of the focus on decision making with two-valued logic, the profession has done precious little work on decision under ambiguity and three-valued logic.[3]

In other words, when I asked us to "take the con out of econometrics" I was only saying the obvious: If the range of inferences that can reasonably be supported by the data we have is too wide to point to one and only one decision, we need to admit that the data leave us confused. Thus my contribution to econometrics has been confusion! You, though, refuse to admit that you are just as confused as I.

Three-valued logic seems especially pertinent when extending the results of experiments into other domains—there is a lot of "we don't know" there. Even in the case of mechanical systems, with statistical properties much better understood than economics/financial human systems, it is not assumed that models will work under extreme conditions. Engineers may design aircraft that according to their computer models can fly, but until real airplanes are actually tested in normal and stressful conditions, the aircraft are not certified to carry passengers. Indeed, Boeing's composite plastic 787 Dreamliner has been suffering production delays because wing damage has shown up "when the stress on the wings was well below the load the wings must bear to be federally certified to carry passengers" (Gates, 2009). Too bad we couldn't have stress-tested those mortgage-backed securities before we started flying around the world with them. Too bad the rating agencies did not use three-valued logic with another bond rating: "AAA-H," meaning hypothetically AAA according to a model but not yet certified as recession-proof.

There is of course more than one reason why mortgage-backed securities didn't fly when the weather got rough, but it will suit my purposes here if I make the argument that it was an inappropriate extrapolation of data from one accidental experiment to a different setting that is at the root of the problem. To make this argument, it is enough to look at the data in Los Angeles. Don't expect a full econometric housing model. It's only a provocative illustration.

Figure 1 contrasts nonfarm payrolls in Los Angeles and in the United States overall during the last three recessions. In 2001 and in 2008, the L.A. job market

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[2] Please don't think I am assigning a uniform distribution over this interval, since if that were the case, the probability would be precisely equal to the mean: 0.10.

[3] Bewley (1986), Klibanoff, Marinacci, and Mukerji (2005), and Hanany and Klibanoff (2009) and references therein are exceptions.

Figure 1
Payroll Jobs in Los Angeles and U.S. Overall
(*recessions shaded*)
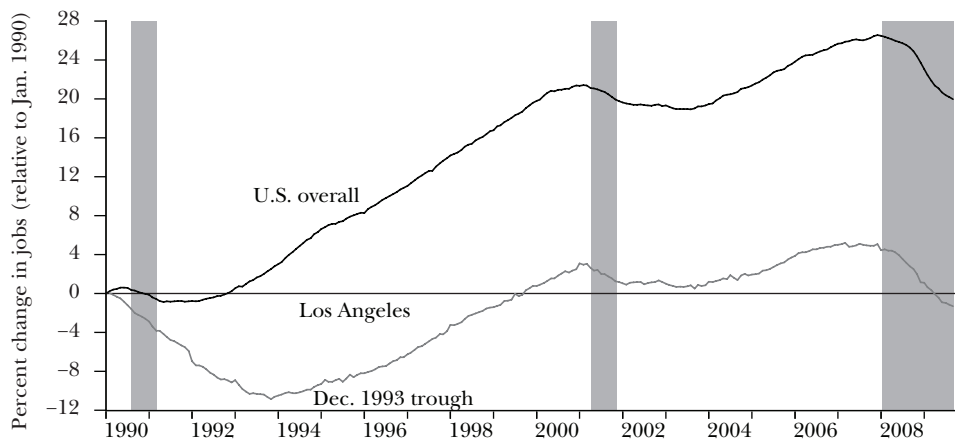
Note: The figure shows the change in number of employees on nonfarm payrolls, in the Los Angeles area and in the U.S. overall, relative to January 1990, seasonally adjusted. The Los Angeles area is the Los Angeles–Long Beach–Santa Ana, California, Metropolitan Statistical Area.

declined in parallel with the U.S. decline, but the recession of 1990–91 was especially severe in Los Angeles. U.S. payroll jobs dropped by 1.5 percent during this recession, while jobs in the Los Angeles metropolitan statistical area declined by 11 percent and did not return to their 1990 levels until 1999. This was a natural experiment known as the end of the Cold War, with Los Angeles treated and with, for example, San Francisco in the control group. (The 2001 recession had the treatment reversed, with San Francisco treated to a tech bust but Los Angeles in the control group.)

Thus, I suggest, the L.A. data in the early 1990s is a test case of the effect of a severe recession on mortgage defaults. Figure 2 illustrates the number of homes sold and the median prices in Los Angeles from January 1985 to August 2009. The horizontal line segments indicate the period over which all homes purchased with a loan to value ratio of 90 percent (indicating a 10 percent downpayment) and interest-only payments will be underwater at the next trough. If all these homes were returned to the banks under the worst case scenario when the price hits bottom, the bank losses are 90 percent of the gap between that line segment and the price at origination. Clearly the underwater problem is much more intense in the latest downturn than it was in the 1990s.

In the first episode, volume peaked much before prices, falling by 50 percent in 28 months. Though volume was crashing, the median price continued to increase, peaking in May 1991, 101 percent above its value at the start of these data in January 1985. Then commenced a slow price decline with a trough in

Figure 2
Los Angeles Housing Market: Median Home Price and Sales Volume
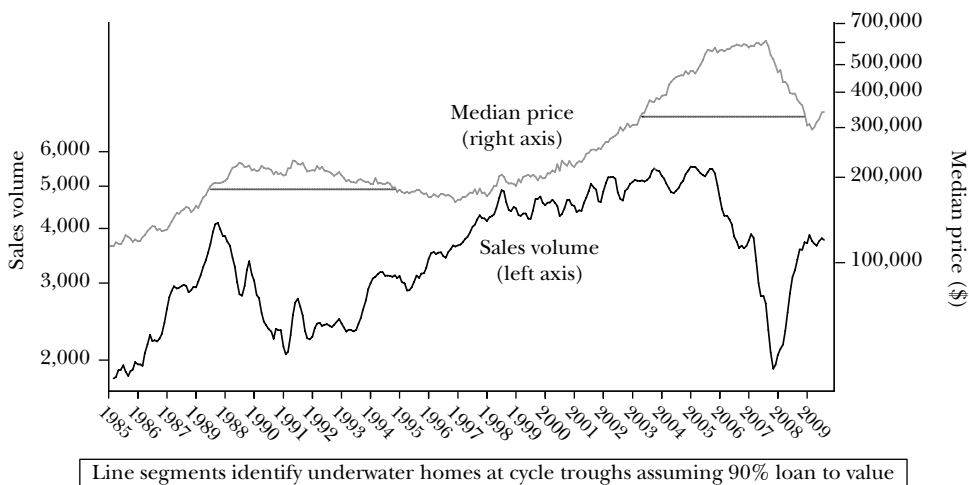
Line segments identify underwater homes at cycle troughs assuming 90% loan to value

Source: California Association of Realtors.
Note: The median price and sales volume are a 3-month moving average, seasonally adjusted. The line segments indentify homes that will be underwater at the coming cycle trough assuming 90 percent loan to value at origination and interest only payments. (Denoting the price at time t by p_t and the price at the trough by p_{min}, with 10 percent down, the loan balance is 0.9 p_t, and the home is underwater at the trough if 0.9 $p_t > p_{min}$ or if $p_t > p_{min} / 0.9$.)

December 1996, with the median price 29 percent below its previous peak, a decline of 5 percent per year.

I have been fond of summarizing these data by saying that for homes, it's a volume cycle, not a price cycle. This very slow price-discovery occurs because people celebrate investment gains, but deny losses. Owner-occupants of homes can likewise hold onto long-ago valuations and insist on prices that the market cannot support. Because of that denial, there are many fewer transactions, and the transactions that do occur tend to be at the seller's prices, not equilibrium market prices.

The slow price discovery acts like a time-out, allowing the fundamentals to catch up to valuations and keeping foreclosure rates at minimal levels.[4] In the early phase of the current housing correction, history seemed to be repeating itself, since volume was dropping rapidly even as prices continued to rise. But then began a rapid 51 percent drop in home prices between August 2007 to March 2009, creating a huge amount of underwater valuation.

[4] The first underwater problem illustrated in Figure 2 could be almost completely remedied by a switch from 90 to 80 percent loan-to-value ratios starting when volumes began to drop, because most of the underwater loans came after that break in the market.

Figure 3
Southern California Foreclosures
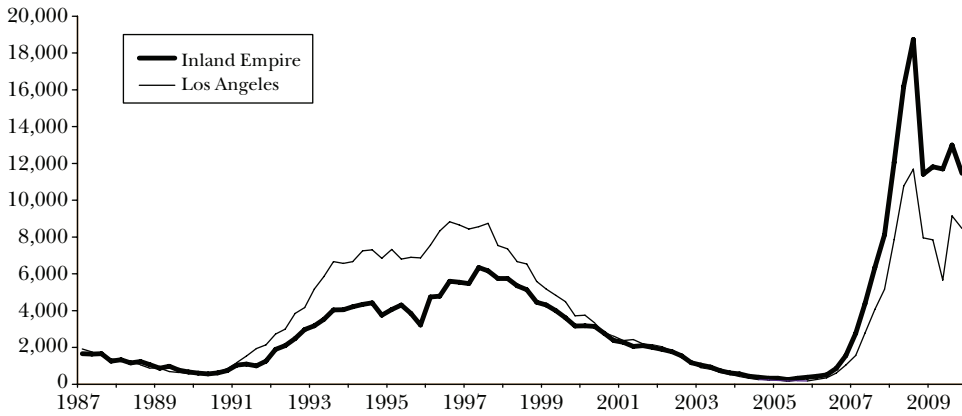
Source: MDA DataQuick.
Note: The concentration of foreclosures in time and space in Southern California in the latest housing correction is illustrated in Figure 3, which displays quarterly foreclosures since 1987 for both Los Angeles County and "The Inland Empire," composed of the two "peripheral" counties east of Los Angeles County (Riverside and San Bernadino), where subprime lending was very prevalent. In both Los Angeles and the Inland Empire in the 1990s, the rise in foreclosures trailed the price movement by several years. In contrast, the time-concentrated spike in foreclosures in 2007 occurred at the very start of the price erosion and has been much more extreme in the Inland Empire than in Los Angeles.

Why did the L.A. 1990s data mislead with regard to the current housing correction? One possible answer is untested social effects and unmeasured subject effects—two very important interactive confounders. Innovations in mortgage origination in 2003–2005 extended the home-ownership peripheries of our cities both in terms of income and location. When the subprime mortgage window shut down, the demand for owner-occupied homes at the extended peripheries was eliminated virtually overnight. Since these properties were financed with loans that could only work if the houses paid for themselves via appreciation, the banks became the new owners. Accounting rules do not allow banks to deny losses the way owner-occupants do, and banks immediately dumped the foreclosed homes onto the market at the worst time, in the worst way, with broken windows and burned-up lawns, concentrated in time and space, causing very rapid (or even exaggerated) price discovery in the affected peripheries. In contrast, foreclosures in the 1990s, illustrated in Figure 3 for the case of Southern California, were delayed, and were dispersed in time and space.

We all need to learn both narrower and broader lessons here. I expected price discovery in housing markets to be slow, as it had been after the bursting of previous bubbles, and I was completely wrong. I will be more careful about interactive social confounders in the future.

White-Washing

It should not be a surprise at this point in this essay that I part ways with Angrist and Pischke in their apparent endorsement of White's (1980) paper on how to calculate robust standard errors. Angrist and Pischke write: "Robust standard errors, automated clustering, and larger samples have also taken the steam out of issues like heteroskedasticity and serial correlation. A legacy of White's (1980) paper on robust standard errors, one of the most highly cited from the period, is the near-death of generalized least squares in cross-sectional applied work."

An earlier generation of econometricians corrected the heteroskedasticity problems with weighted least squares using weights suggested by an explicit hetero-skedasticity model. These earlier econometricians understood that reweighting the observations can have dramatic effects on the actual estimates, but they treated the effect on the standard errors as a secondary matter. A "robust standard" error completely turns this around, leaving the estimates the same but changing the size of the confidence interval. Why should one worry about the length of the confidence interval, but not the location? This mistaken advice relies on asymptotic properties of estimators.[5] I call it "White-washing." Best to remember that no matter how far we travel, we remain always in the Land of the Finite Sample, infinitely far from Asymptopia. Rather than mathematical musings about life in Asymptopia, we should be doing the hard work of modeling the heteroskedasticity and the time dependence to determine if sensible reweighting of the observations materially changes the locations of the estimates of interest as well as the widths of the confidence intervals.

Estimation with instrumental variables is another case of inappropriate reliance on asymptotic properties. In finite samples, these estimators can seriously distort the evidence for the same reason that the ratio of two sample means, $\overline{y}/\overline{x}$, is a poor summary of the data evidence about the ratio of the means, $E(y)/E(x)$, when the finite sample leaves a "dividing-by-zero-problem" because the denominator $\overline{x}$ is not statistically far from zero. This problem is greatly amplified with multiple weak instruments, a situation that is quite common. It is actually quite feasible from a Bayesian perspective to program an alert into our instrumental variables estimation together with remedies, though this depends on Assumptions. In other words, you have to do some hard thinking to use instrumental variables methods in finite samples.

As the sample size grows, concern should shift from small-sample bias to asymptotic bias caused by the failure of the assumptions needed to make instrumental variables work. Since it is the unnamed, unobserved variables that are the source of the problem, this isn't easy to think about. The percentage bias is small if

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[5] The change in length but not location of a confidence interval is appropriate for one specialized covariance structure.

the variables you have forgotten are unimportant compared with the variables that you have remembered. That's easy to determine, right?

A Word on Macroeconomics

Finally, I think that Angrist and Pischke are way too optimistic about the prospects for an experimental approach to macroeconomics. Our understanding of causal effects in macroeconomics is virtually nil, and will remain so. Don't we know that? Though many members of our profession have jumped up to support the $787 billion stimulus program in 2009 as if they knew that was an appropriate response to the Panic of 2008, the intellectual basis for that opinion is very thin, especially if you take a close look at how that stimulus bill was written.

The economists who coined the DSGE acronym combined in three terms the things economists least understand: "dynamic," standing for forward-looking decision making; "stochastic," standing for decisions under uncertainty and ambiguity; and "general equilibrium," standing for the social process that coordinates and influences the actions of all the players. I have tried to make this point in the title of my recent book: *Macroeconomic Patterns and Stories* (Leamer, 2009). That's what we do. We seek patterns and tell stories.

Conclusion

Ignorance is a formidable foe, and to have hope of even modest victories, we economists need to use every resource and every weapon we can muster, including thought experiments (theory), and the analysis of data from nonexperiments, accidental experiments, and designed experiments. We should be celebrating the small genuine victories of the economists who use their tools most effectively, and we should dial back our adoration of those who can carry the biggest and brightest and least-understood weapons. We would benefit from some serious humility, and from burning our "Mission Accomplished" banners. It's never gonna happen.

Part of the problem is that we data analysts want it all automated. We want an answer at the push of a button on a keyboard. We know intellectually that thoughtless choice of an instrument can be a severe problem and that summarizing the data with the "consistent" instrumental variables estimate when the instruments are weak is an equally large error.[6] The substantial literature on estimation with weak instruments has not yet produced a serious practical competitor to the usual

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[6] Bayesians have a straightforward solution in theory to this problem: describe the marginal likelihood function, marginalized with respect to all the parameters except the coefficient being estimated. If the instruments are strong, this marginal likelihood will have its mode near the instrumental variables estimate. If the instruments are weak, the central tendency of the marginal likelihood will lie elsewhere, sometimes near the ordinary least-squares estimate.

instrumental variables estimator. Our keyboards now come with a highly seductive button for instrumental variables estimates. To decide how best to adjust the instrumental variables estimates for small-sample distortions requires some hard thought. To decide how much asymptotic bias afflicts our so-called consistent estimates requires some very hard thought and dozens of alternative buttons. Faced with the choice between thinking long and hard versus pushing the instrumental variables button, the single button is winning by a very large margin.

Let's not add a "randomization" button to our intellectual keyboards, to be pushed without hard reflection and thought.

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